INDIAN CALENDRIC SYSTEM

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PREFACE

There have been several rquests for calendric astronomers in India as well as from those in foreign countries to inform them of any publication which give briefly in a clear manner the working of the Indian calendric system including the astronomical principles on which it is based, and also the method generally followed for fixing the date and time for celebrating the traditional festivals.

It is difficult to find any publication which gives all the required information in a systematic and scientific manner. The information needed is somewhat scattered, and is not readily available in a simple and compact form for easy understanding. This book is intended to meet to some extent this requirement. It explains briefly with the help of diagrams and tables the astronomical principles of the working of the Indian calendric system which has been guiding the religious and social life of the Indian people for more than a millennium and a half. It also contains a few examples indicating the principles generally followed for determining the date and time for celebrating the festivals and anniversaries for the purpose of giving a broad idea of the method and practice involved in fixing such dates. This book incidentally deals with matters that concern calendar proper, and not with all panchang items which some persons presume are encompassed by the term calendar.

It is hoped that this book will be useful for understanding the astronomical basis as well as the working principles of our traditional calendric system. It should also be helpful to appreciate the necessity to standardise the different conventions followed in different regions so as to bring about the much desired uniformity in our calendric system, and also the need for the old school panchang makers who are still using out-of-date inaccurate method for calculating astronomical items of panchang, to adopt the correct modern method which is based on the positions of luminaries that tally with their observed positions in the sky.

I am grateful to Prof J.C. Bhattacharyya, former Director, Indian Institute of Astrophysics; and Prof A.K. Chakravarty, former Professor of Mathematics, Mahishadal Raj college for kindly perusing the draft, and making some suggestions.

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14 January, 1998
(Makara Samkranti)

S.K.Chatterjee

CONTENTS

Diagrams and Tables

FOREWORD

The knowledge and measurement of time is a fundamental parameter required for all human activities. From time immemorial man has devised various ingenious methods to reckon time. For measuring time, some precise and standard yard stick is required and the most obvious choice for such a yard stick could not be better than the rhythmic natural motion of the Sun, Moon, Earth and planets. Our Sun is the governor of the solar system; all the planets revolve around it. The Earth revolves around the Sun, the time it takes to go once around the Sun, provides a very precise and convenient measure of time - known as one Solar year. The time taken for the Earth to rotate on its own axis is considered as one Solar day or simply one day. Similarly, our Moon revolves around the Earth; this periodic motion marks one Lunar month. The tilt of the Earth's rotational axis provides us the four seasons. Many ancient civilizations had made precise observations of the movement of celestial objects and from these observations they developed time reckoning techniques and calendars. Ancient societies needed to know the time and period for sowing and harvesting of the crops time for various festivals and rituals etc., thus emerged the concept of time keeping and the calendar. It was most natural for the early man to look up towards the sky and study the movement of the celestial objects, specially the Sun, Moon, and the planets.

To understand the motions of the Moon and planets is easy and straightforward, but to comprehend the combined effect of the various movements of celestial bodies becomes rather complicated. For example, due to elliptical orbit of the Earth around the Sun, the rate at which the Earth goes around the Sun is not constant. During the summer months of June-July (in Northern Hemisphere), the Earth travels slower as compared to, during the winter months of December - January. The tilt of Earth's axis further complicates the matter. The Earth's axis 'precesses' in space, thus its north end, now pointing very nearly towards the Pole star (Dhruva tara), will not be doing so after a period of time, owing to continuous and slow change of this direction caused by this precession. This precessional motion complicates reckoning of position of celestial objects in the sky, because the 'zero' point for measuring the longitude of objects itself changes. Astronomy has provided precise measurements of all these motions and positions of celestial objects in the sky, which helped to measure time and develop calendar etc. However, to explain these complicated phenomena and intricacies of various calendars, requires considerable skill and understanding.

Commodore S.K. Chatterjee, the author of this book has done a commendable job to lucidly describe the intricacies of various regional Indian calendars. It was quite natural for highly developed ancient societies like India, to have their own regional time reckoning methods and calendars, thus several regional calendars emerged in our country. After India's independence and integration of the whole country and improvement of communications, it was felt that India should have one single Indian

calendar instead of so many regional calendars. For this purpose Pandit Jawaharlal Nehru, our first Prime Minister, constituted a high power Calendar Reform Committee under the eminent scientist - Professor M.N. Saha. This Committee recommended a National Calendar, which was officially adopted by the Indian Government. However, due to several reasons this National Calendar is not being widely accepted or used in the whole country. Cmde Chatterjee's efforts to devise a commonly accepted Indian calendar and also to standardize different practices followed in our calendric system are indeed commendable. His wide experience and study of India Calendric science, which he has elucidated in this book, is indeed a very good attempt. I congratulate him to bring out a comprehensive book on the Indian Calendric System in English language. I am sure that this book will be very useful for those who want to understand the intricacies of Indian calendar.

Professor Arvind Bhatnagar,
Former Director of Udaipur Solar Observatory,
CSIR Emeritus Scientist.

January 1998.

Calendar : Meaning and Different Types

Calendar is a method for counting in a systematic and continuous manner the successive days in the ever-flowing aeon of time by convenient cyclic periods in units named as year. The measure of this year has been the motion of the two prominent luminaries in the sky, namely the sun and the moon. The time period of the successive return of the sun to the same reference point in its path in the sky, which is really the time period of the revolution of the earth around the sun, forms the measure of the solar year, and is the basis of all solar calendars. Again the time period of the successive return of the moon in conjunction or opposition to the sun in relation to the earth, which is the time period from new moon to new moon, or full moon to full moon, is the measure of the lunar month, and twelve such months form the lunar year, and this is the basis of lunar calendars. The Indian calendric system comprise of both solar and lunar calendars. But the lunar year being shorter than the solar by about 11 days, the Indian lunar calender, unlike the pure lunar Islamic Hejira calendar, is kept adjusted to the solar calendar and hence to the seasons by addition of an intercalary month at suitable intervals, and such a lunar calendar is known as luni-solar calendar. The Indian calendric system comprises of both these types of calendar, namely solar and luni-solar.

It has been mentioned that the year of the solar calendar is measured on the time taken by the sun to return to the same reference point in it's path in the sky. But there have been two schools in choosing this point. One school takes a fixed point in the sun's path as the reference point, and this is done by fixing this point with reference to background stars which for all general purposes are taken to be fixed in the sky, and this type of year is thus known as sidereal. In this system the year becomes the measure of the time taken by the earth to make a complete revolution of 360° around the sun, and this from the earth is seen as the sun making a complete journey of 360° along it's path in the sky.

On the other hand, the earth's axis being inclined to the plane of it's orbit by about 23.5°, the sun's path on the celestial sphere is intersected at two points by the earth's equator projected on that sphere, known as celestial equator. The intersection point at which the sun climbs up north of equator, which takes place on or about 21 March, is taken as the reference point by the other school.

But the difficulty has been that the aforementioned two intersection points are constantly receding westwards at the present rate of 50".3 per year along the sun's

path due to precessional motion of the earth which makes the direction of the earth's axis to precess in a circle around the pole of the earth's orbit. For this reason the year of this school becomes the time taken by the earth to revolve around the sun by $360° - 50''.3$, and so the length of this year, known as tropical year, is less than the sidereal year by about $20^m 24^s$. This year is taken to conform with the seasons because the spring season is taken to commence when the sun is at the reference intersection point and it starts moving northwards in relation to the equator. This happens as already mentioned on or about 21 March of tropical Gregorian calendar. On this day, length of the day and that of the night is equal, the sun being also on the equator at that time, and is called Spring or March equinox day.

Again, as regards lunar calendar, the method of adding intercalary months to the lunar year to keep it adjusted to the solar calendar and hence to the seasons, is not the same for the Indian calendar as that followed by the Jewish and other similar lunisolar calendars. These latter calendars follow a mechanical system for inserting the intercalary months, but in the Indian calendar an astronomical device is followed to ascertain when such months are to be added. Details of various types of calendars in use and their astronomical basis have been detailed in subsequent chapters. ∎

Ecliptic, Celestial Equator and Equinoxes

The solar year is the time period of the earth's revolution around the sun, but from the earth the sun appears to move amid the stars in the sky, and so the time period of the return of the sun to the same reference point in the sky is taken as the measure of the year. The apparent annual path of the sun on the celestial sphere is known as ecliptic. It may be expressed as the projection of the earth's orbit around the sun on the celestial sphere. This great circle was originally called as 'ecliptic' because it was noticed that eclipses only occurred near the times when the moon at conjunction or opposition to the sun crossed this path of the sun in the sky.

The earth is rotating on its axis and at the same time it is revolving around the sun. This rotation causes the continuous cycles of day and night, and it being from west to east, the sun appears to rise on the east and set on the west. Further, this diurnal motion of the earth also causes the stars to rise similarly on the east horizon and set on the west. The revolution of the earth around the sun causes the succession of years, and from the earth the sun appears to move amid star constellations lying along the ecliptic in the direction from west to east. This apparent motion is also true for other planets which are revolving around the sun.

However, the axis of this spinning earth is inclined to the plane of its orbit from its perpendicular line by about 23° 26'. This is reflected in the ecliptic being inclined to the celestial equator, which is the projection of the earth's equator on celestial sphere, by the same angle, and also it is intersected by the celestial equator at two opposite points which are known as equinox or equinoctial point. The equinox at which the sun crosses the equator from south to north is known as vernal or spring equinox because in the northern hemisphere it generally marks the start of the spring season though in countries in the torrid zone ordinarily it is the middle of the spring season. This equinox is also known as March equinox because the sun is on the vernal equinox on or about 21 March. The more important reason is that in the southern hemisphere seasons occur in an opposite manner, namely when it is spring in the northern hemisphere, then it is autumn in the southern hemisphere, and the name March equinox is more appropriate and universal. Again at the equinox placed opposite to the vernal, the sun crosses the equator from north to south, and it is known as autumnal equinox because it is taken to be the start of the autumn season in the northern hemisphere. It is also sometimes called September equinox because the event takes place about 23 September, and also for reasons alluded earlier, it is applicable for both the hemispheres. Incidentally, the intersection points of the ecliptic with the equator are called equinoxes because when the sun is on this point, it is also

on the equator which cuts the horizon at east and west points, and the sun then rises due east and sets due west. The lengths of the day and of the night on that day are equal, and hence this day is called equinox day, and the point is called equinox or equinoctial point.

From vernal equinox the sun starts climbing upwards towards north in relation to the equator, and when it moves 90° away in the anti-clockwise direction from vernal equinox, it attains the highest northern declination and reaches the greatest altitude. This day is called summer solstice day, and this point, placed midway between vernal and autumnal equinox, is called summer solstice point or solstitial point. The sun moves to this point at about 21 June, and this day is called summer solstice day because in the northern hemisphere, it is generally the middle of summer season, though in India it is the time when monsoon rains have started after the summer. From summer solstice day, the sun starts moving down towards south, and when it has moved 180° along the ecliptic from summer solstice, the winter solstice takes place in the northern hemisphere, which happens at about 22 December. On this day the sun's altitude is least, and southern declination is greatest. The name 'solstice' has been derived from the fact that when the sun arrives at these points in the ecliptic, it is seen to stop moving in altitude and 'stands' for a few days before it starts chainging its declination and altitude. Diagram I placed at page 6 illustrates the positions of ecliptic, celestial equator, equinoxes and solstices on the celestial sphere. ∎

Precessional Motion of the Earth

The earth, apart from having the well known motions of rotation and revolution, has another motion called 'precession'. Due to the forces of attraction of the moon and the sun, both nearly in the same ecliptic plane, acting upon the earth's equatorial bulge, the axis of the earth makes a very slow conical motion around the pole of its orbit about the sun, which is the same as the pole of the ecliptic. This motion is made in a counter clockwise direction but maintaining the same inclination to its orbital plane. In other words, the earth's axis describes a cone of semi-vertical angle of 23° 26', which is the inclination of its axis from the vertical, and this causes the celestial pole to describe a circle around the ecliptic pole on the celestial sphere of the an angular radius of 23° 26'. The rate of this precessional motion the earth's axis is at present 50".3 in celestial longitude, and thus it takes about 25,800 years for the celestial pole to make a circle around the ecliptic pole. The direction of the earth's axis is thus not fixed in space, and at present it is pointing very near towards the star Polaris known as 'Dhruba Tara' in Indian language. At about 4000 AD or so, the celestial pole will move to the position of γ Cepheus, at about 7000 AD or so, near to ∝ Cepheus, and at about 14000 AD or so the north end of the earth's axis will be pointing towards the star Vega.

The precessional motion of the earth causes the two intersection points of the ecliptic with the celestial equator, which are the equinoxes or equinoctial points, to slide westwards on the ecliptic, keeping the same angle between the two, at the aforesaid rate of 50". 3 per year in celestial longitude, and this is known as 'precession of the equinoxes'. This phenomenon has a very important bearing on calendar making, and is the cause of difference between tropical and sidereal calendars. Diagram II, placed at page 6 shows how due to precessional motion of the earth, the celestial pole moves around the ecliptic pole in a circular path of angular radius of 23° 26', and also the approximate years when the north end of the earth's axis will be pointing towards different stars at different distant ages.

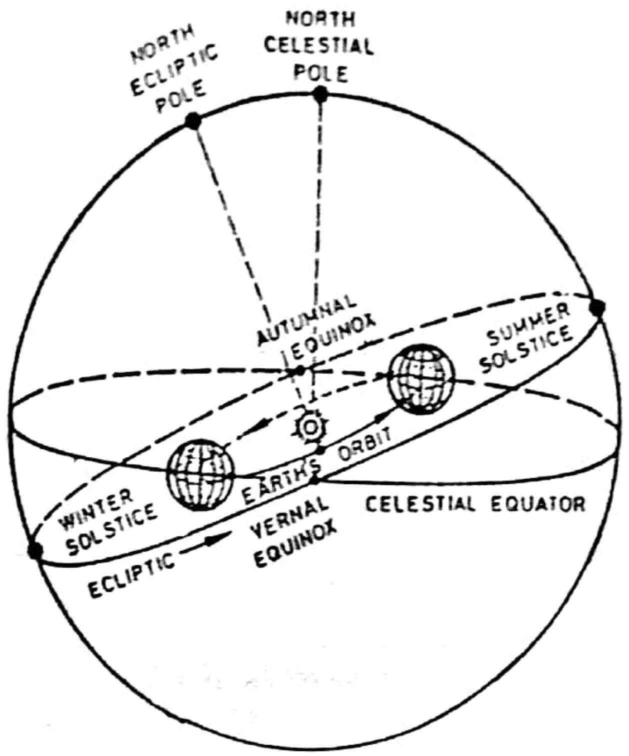


Diagram I. Relative positions of the ecliptic and the celestial equator, north ecliptic pole and north celestial pole, the equinoxes and the solstices on the celestial sphere.

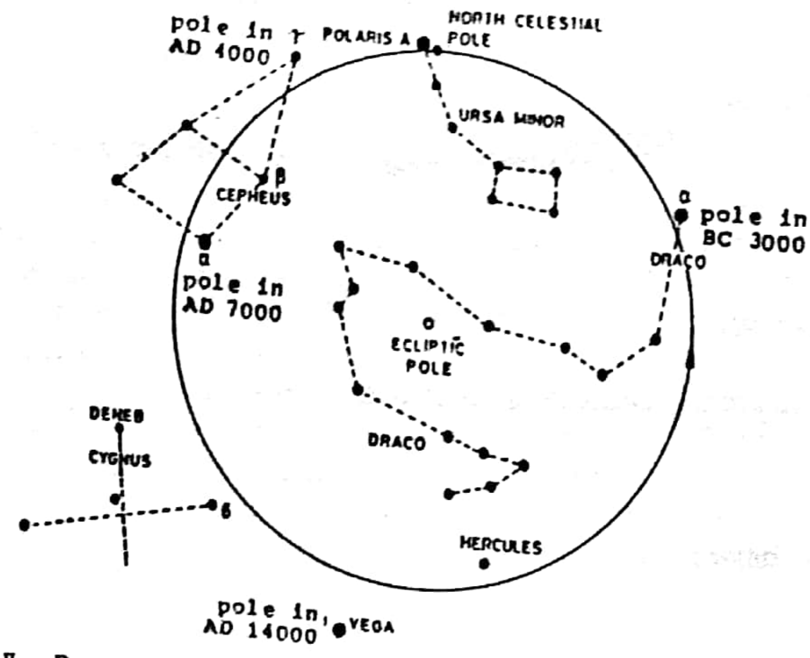


Diagram II. Precessional path of the north celestial pole.

Due to precessional motion of the earth, the celestial poles move around the ecliptic poles in a circular path of radius of 23.5°. Facing north, this motion of the north celestial pole is counter clockwise. This pole which is now very close to star Polaris, will move to different positions as shown in the Diagram. Under the present rate of precession of 50".27 per year, the celestial pole makes a circle around the ecliptic pole in a period of about 25,800 years.

Solar Calendar

The measure of the year of the solar calendar, as mentioned, earlier, is the time period of successive returns of the sun to the same reference point on the ecliptic. This point can be either, (1) a fixed point on the ecliptic with reference to a background star which for all such purposes is taken to be fixed, or (2) any of the two equinoxes or equinoctial points, which for calendrical and astronomical purposes is normally taken to be the vernal or March equinoctial point. This point is also called as the 'First of point of Aries' because in this system, known as tropical system, which is followed by western (or modern) astronomers, the first zodiac sign Aries is reckoned to start from this point on the ecliptic, and accordingly also the co-ordinates of the heavenly bodies along the equator or the ecliptic is measured by taking this point as the first point. However, as explained earlier, this point is not a fixed one, and it is receding towards the west @ 50". 3 per year in celestial longitude. Hence the relation of the tropical zodiac signs with the background star constellatios of the same name is constantly changing, and at present the 1st point of Aries has shifted to the constellation Pisces. For this reason, the positions of the stars indicated by the tropical co-ordinate system on the basis of measurements taken from 1st point of Aries do not remain the same.

The first method mentioned in the preceding paragraph for measuring the year from a fixed point on the ecliptic, is known as sideral or nirayana system, and is followed in India in the traditional calendar. Here the fixed initial point is reckoned to be that in the ecliptic which is placed opposite the bright star Chitra (Spica - α Virginis) located close to the ecliptic. It means that when this initial point was fixed the longitudinal position of the star Chitra was 180°. In order to assign a firm position to this initial point for astronomical purposes, this fixed initial point is reckoned to be the vernal equinoctial point of the vernal equinox day of 285 AD (207 Saka) which happened on 20 March at 22h 53m, IST, when the longitude of the star Chitra from this point was 179° 59' 52" which for all practical calendrical purposes may be taken to be 180°. It may be mentioned that the stars are not absolutely fixed in the sky; they are observed to have a very slow motion known as 'proper motion', and for this reason Chitra's aforementioned longitude from the fixed initial point is now less by about 58". As previously mentioned, due to precessional motion of the earth, the vernal equinox is receding on the westwards at the rate of 50".3 per year, and as such the vernal equinox point which coincided with the fixed initial point of nirayana zodiac at 285 AD, has shifted on 1 Jan 97 by nearly 23° 49′ towards the west. The angular longitudinal distance of the vernal equinoctial point from the fixed initial point at any

point of time is called as 'ayanamsa' of that time, and this angle is the same as the tropical longitude of the fixed initial point.

The length of the year is measured, as already mentioned, on the successive return of the sun to the same reference point on the ecliptic. In the case of sidereal or nirayana year which has a fixed initial or reference point, the earth makes a complete revolution of 360° around the sun, which from the earth is observed as the sun returning to the same fixed initial point on the ecliptic, and the mean length of this year measures as 365.256363 days. On the other hand, in tropical or sayana year, the earth makes a revolution around the sun by 50". 3 less than 360° due to westwards recession of the vernal equinox by that angle each year, and hence the length of the tropical or sayana year measures 365.24219 days, which is short of the sidereal year by 0.014173 day or by 20^m 24^s. 5 Here lies the fundamental difference between the sidereal and tropical calendric systems. In the tropical Gregorian calendar, to compensate for 0.24219 day which is left over after counting the normal years as 365 days, a leap year of 366 days is privided at every Gregorian (Christian) era year divisible by four, but not in century years unless divisible by 400, so that there are 97 leap years in a period of 400 years, and as such the mean length of the year of the Gregorian calendar works out as 365.2425 days. In nirayana or sidereal year calendar when the months have fixed number of days and the normal years have 365 days, then to compensate for the left over period of 0.256363 day, there will be continuous leap years, including century years, at intervals of four years, and also there will be additional leap years mathematically at intervals of 157 years, which may be rounded to 160 years for ease of reckoning this year in the calendar. Alternatively, to compensate for the uncounted length of 0.256363 day, 10 leap years may be provided in each cycle of 39 years.

The Indian calendric system is based mainly on the calendric principles laid down in the ancient astronomical treatise named as Surya Siddhanta. It is not known when this book was originally written and published, and who was its real author, but it is believed that the siddhantic calendric system came into use around C 400 AD. The surya siddhantic length of the sidereal year is 365.258756 days, and this is longer than the modern correct length by 3m 27s, but a few limited conservative panchang makers are still using this old length of the year. Incidentally, the length of the year is not constant; the lengths mentioned above are mean values. The actual length fluctuates from the aforesaid mean values, and in the case of sidereal year the variation from the mean value may be as much as ± 9 minutes. Again it may be remembered that the sun transits to nirayana Mesha rasi in each successive year later by about 6 hours and a few minutes, and as such this transit takes place at different times of day and night. This affects the determination of the starting day of the traditional solar year and similarly also of the months because of following of different conventions in different regions in determining the starting day of the month based on the time of transit of the sun to the concerned rasi. This has been elaborated later.

The zodiac belt, through the middle of which lies the ecliptic, is divided into 12 equal divisions, and each part thus covers 30° of arc on the ecliptic, and is called as 'zodiac sign' or 'Rasi'. In the tropical or Western system, the start of these divisions is

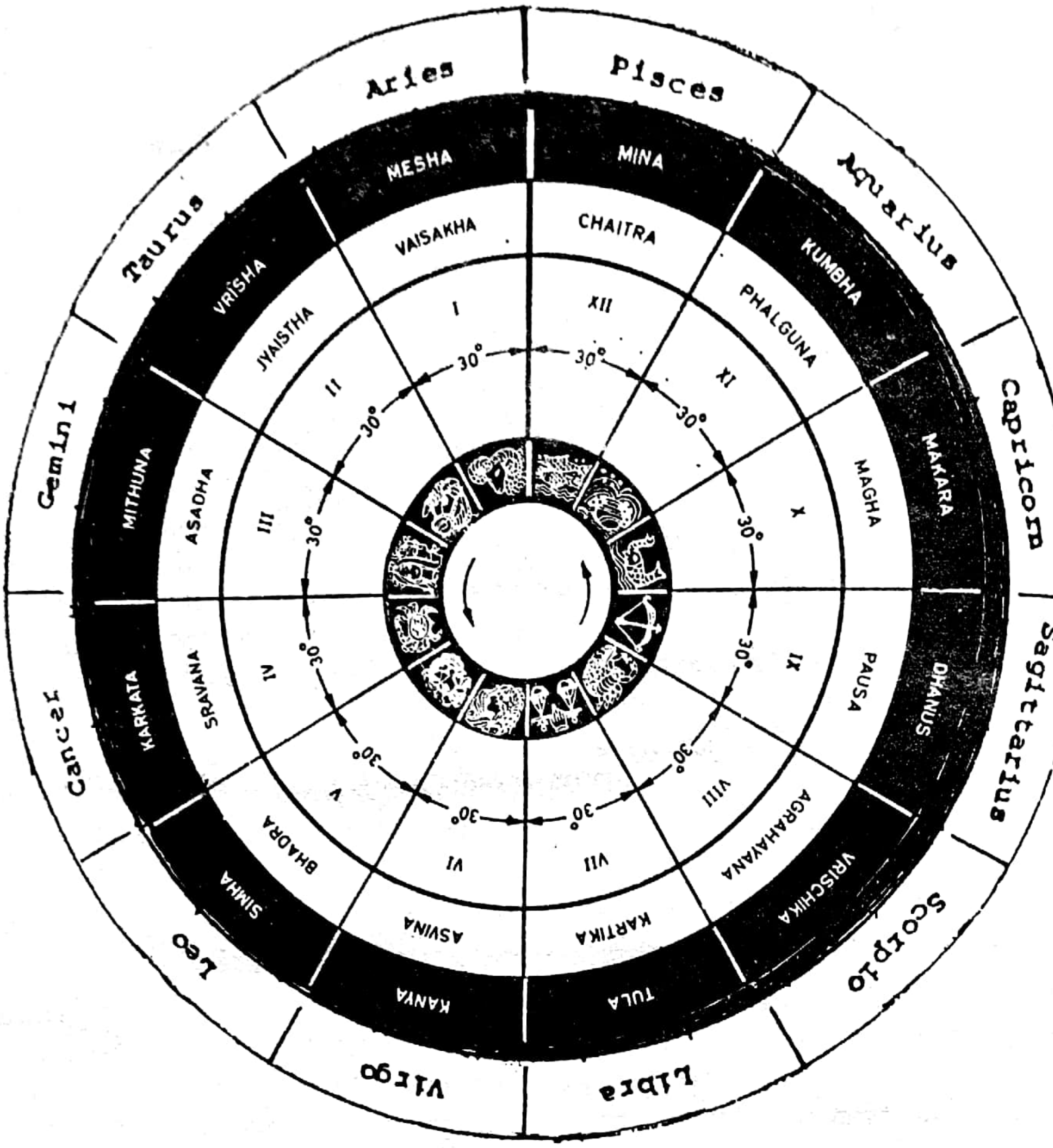
from the vernal equinoctial point, but in the sidereal (nirayana) or Indian system, the start of the divisions is made from the earlier mentioned fixed initial point from which Mesha rasi starts. In the list below, English names of the Zodiac signs which correspond to Indian rasi names, have been shown within brackets. The twelve rasis are named as (1) Mesha (Aries), (2) Vrisha (Taurus), (3) Mithuna (Gemini), (4) Karkata (Cancer), (5) Simha (Leo), (6) Kanya (Virgo), (7) Tula (Libra), (8) Vrischika (Scorpio), (9) Dhanus (Sagittarius), (10) Makara (Capricon), (11) Kumbha (Aquarius), and (12) Mina (Pisces).

The nirayana year comprises of 12 solar months and these are directly linked with tweleve respective rasi divisions. This has meant in the length of the months being reckoned on the basis of time taken by the sun to traverse the respective linked rasis, which is the period covered from the time at which the sun enters the concerned rasi known as Samkranti, to the time it enters the next rasi. The name of the twelve months and the rasis with which these months are linked are as follows : (1) Vaisakha (Mesha), (2) Jyaistha (Vrisha), (3) Ashadha (Mithuna), (4) Sravana (Karkata), (5) Bhadra (Simha), (6) Asvina (Kanya), (7) Kartika (Tula), (8) Agrahayana or Margasirsha (Vrischika), (9) Pausha (Dhanus), (10) Magha (Makara), (11) Phalguna (Kumbha), and (12) Chaitra (Mina). In Tamil solar calendar, the 1st month starts as above with the sun entering Mesha rasi, the 2nd month with the sun entering Vrisha rasi, and so on, but the 1st month is named as Chittirai, meaning Chaitra, and the 2nd one as Vaikasi, meaning Vaisakha, that is, the months have names as the previous ones of the above shown calendar which is followed in other regions. Names of the remaining 10 months of Tamil calendar, some of which have pure Tamil base, are as follows : (3) Ani, (4) Adi, (5) Avani, (6) Purattasi, (7) Arppisi, (8) Karthigai, (9) Margali, (10 Thai, (11) Masi, and (12) Panguni. In Kerala, the months have no separate names, and they are called after the name of the rasis, and the year starts with the sun entering Simha rasi. Diagram III placed at page 10 shows the relationship of the months of the nirayana calendar with the rasis.

The ingress of the sun from one rasi to the next, known as 'samkranti', however, may take place at any time of day or night, but the day of the month of the traditional calendar, known as savana day, or panchang day, starts with sunrise. Therefore, depending on the time of samkranti and on the convention followed to determine the starting day for the month, there being four different conventions for four different regions, (see page 14), the month may commence on the day of samkranti, or on the following day, or sometimes in some region, the day after. This procedure has been causing the unsatisfactory situation that the same month sometimes starts on different days in different regions which in turn then makes the same months in not having same number of days in the same year in these regions. Again the same months in the same region may not have in all years the same number of days. This modus operandi has made the traditional solar calendar in the present form unsuitable for general civil use. However, it can be made easily suitable by having fixed number of days for the months.

The regional solar calendars are generally grouped under four schools, known as Bengal, Orissa, Tamil, and Malayali Schools. For reasons stated in the previous paragraph, and further elaborated later, the starting days and length of the months of

Diagram III Relationship of the months of the nirayana solar panchang calendar with the rasis.



The year of the nirayana or sidereal Indian calendar starts when the sun moves to the 1st point of Mesha rasi, on or about 14 April, which is 1st of Vaisakha. This fixed 1st point of the nirayana zodiac is located almost opposite, that is at a longitudinal distance of 180°, of the star Chitra, (α Virginis)

The vernal equinoctial point coincided with the fixed initial point of nirayana zodiac on the vernal equinox day of 285 AD, and this equinoctial point is constantly receding to the west, the present rate being 50.3 per year. The angular distance on the ecliptic through which the vernal equinoctial point has receded at any time from the above fixed initial point is known as "ayanamsa" of that time, and its value on 1 Jan 97 was nearly 23°49′.

English names of zodiacal signs, namely Aries, Taurus, etc. have been shown in the diagram above against the corresponding Indian sidereal zodiacal signs or rasis which are respectively Mesha, Vrisha, etc, for ease of understanding the Indian system, and also for indicating similarity between the two signs when both have the same initial point.

Table I : Beginning of the months and their lengths of solar calendars of different regions (Schools) for years

Saka year : 1917 (1955-96 AD) and 1916 (1994-95 AD), or
Vikram Samvat year : 2052 and 2051, or
Kali year : 5096 and 5095

Sl No	Name of months	Bengal School				Orissa School				Tamil School				Malayali School			
		1917 Saka 2052 Vikram 1402 B.S.		1916 Saka 2051 Vikram 1401 B.S.*		1917 Saka 2052 Vikram		1916 Saka 2051 Vikram		1917 Saka 2052 Vikram		1916 Saka 2051 Vikram		1917 Saka 2052 Vikram 1171 Kollam		1916 Saka 2051 Vikram 1170 Kollam	
		Start of month	No of days	Start of month	No of days	Start of month	No of days	Start of month	No of days	Start of month	No of days	Start of month	No of days	Start of month	No of days	Start of month	No of days
1.	Vaisakha	15 Apr 1995	31	15 Apr 1994	31	14 Apr 1995	31	13 Apr 1994	31	14 Apr 1995	31	14 Apr 1994	31	14 Apr 1995	31	14 Apr 1994	31
2.	Jyaishtha	16 May	31	16 May	31	15 May	31	14 May	32	15 May	31	15 May	31	15 May	32	15 May	31
3.	Ashada	16 Jun	32	16 Jun	31	15 Jun	31	15 Jun	31	15 Jun	32	15 Jun	32	16 Jun	31	15 Jun	32
4.	Sravana	18 Jul	31	17 Jul	32	16 Jul	32	16 Jul	31	17 Jul	31	17 Jul	31	17 Jul	31	17 Jul	31
5.	Bhadra	18 Aug	31	18 Aug	31	17 Aug	31	16 Aug	31	17 Aug	31	17 Aug	31	17 Aug	31	17 Aug	31
6.	Asvina	18 Sep	30	18 Sep	30	17 Sep	30	16 Sep	31	17 Sep	31	17 Sep	30	17 Sep	31	17 Sep	31
7.	Kartika	18 Oct	30	18 Oct	30	17 Oct	30	17 Oct	30	18 Oct	30	17 Oct	30	18 Oct	30	18 Qct	30
8.	Agrahayana	17 Nov	30	17 Nov	30	16 Nov	30	16 Nov	29	17 Nov	29	16 Nov	30	17 Nov	29	17 Nov	29
9.	Pausha	17 Dec	29	17 Dec	29	16 Dec	29	15 Dec	30	16 Dec	30	16 Dec	29	16 Dec	30	16 Dec	30
10.	Magha	15 Jan 1996	30	15 Jan 1995	30	14 Jan 1996	30	14 Jan 1995	29	15 Jan 1996	29	14 Jan 1995	30	15 Jan 1996	29	15 Jan 1995	29
11.	Phalguna	14 Feb	30	14 Feb	30	13 Feb	30	12 Feb	30	13 Feb	30	13 Feb	30	13 Feb	30	13 Feb	30
12.	Chaitra	15 Mar	30	16 Mar	30	14 Mar	30	14 Mar	30	14 Mar	30	15 Mar	30	14 Mar	31	15 Mar	30

* B.S. means Bengali San

these Schools differ. For example, this difference for Saka years 1917 and 1916 had been shown in Table I, placed at page 11. The actual time taken by the sun to traverse the rasis varies from 29.45 to 31.45 days in accordance with Kepler's laws applicable to elliptical orbit of the planets, and for this reason the length of the months of panchang solar calendar varies from 29 to 32 days. It may, however, be remarked that as the length of the month is dependent on the time taken by the sun to traverse the linked rasis, only the months of Jyaishtha, Ashadha, and Sravana can have 32 days because under the Kepler's law the earth being then farthest from the sun, moves comparatively slower, and likewise the months of Agrahayana, Pausha, and Magha can have only 29 days because then the earth being closest to the sun, moves faster.

As mentioned earlier, the correct length of the nirayana or sidereal year is of 365.256363 days, and so if lengths of the months are fixed, the years will have normally 365 days. But to keep the year adusted to its above proper length, an extra day or leap day has to be added to the above normal length of the year at some intervals. When this is done, the year becomes of length of 366 days, and is called a leap year. The correction to be made to the normal year of 365 days, is for the left over length of 0.256363 day, and this will accumulate to 1 day in 1 ÷ 0.256363 = 3.9007 years. It means that in a period of 39 years, 10 days are to be added, that is, there will be 10 leap years in this period. As the traditional nirayana calendar has no fixed number of days for its months like the Gregorian calendar, there is no laid down mechanical rule for determining the year which will be a leap year for this calendar. The starting day of the year and consequently its length is dependent on the actual time of transit of the sun to the 1st rasi, which is Mesha rasi, and the convention followed in determining the starting day for the months, and as such in actual practice leap years automatically occur at an interval of four and three years so that 10 leap years occur in a period of 39 years as needed to keep the year corrected to its proper length.

Table II at page 13 indicates the starting dates and the length of the years of the four Schools of keeping of traditional calendars from Saka 1900 to 1916. This Table illustrates how normal years and leap years have occurred during this 17 year period. It will be observed that under Malayali or Kerala School the leap year in 1905-06 Saka has occurred at the third year from the previous one, and this tends to confirm the occurrence of some leap years at 3 year interval from the previous one, so that 10 leap years occur in a period of 39 years as required. It may be added, as explained earlier, that if the length of the months of the nirayana calendar is made fixed, then a laid down method of having leap years would have to be adopted. This will be to have leap years at every fourth year, and an additional one in each cycle of 160 years or so. Alternatively to have, as also mentioned earlier, 9 leap years at 4-year intervals, and the 10th, leap year at 3-year interval in cycles of 39 years.

It has been mentioned that the starting day of the month of the nirayana solar calendar is determined on the time of transit (samkranti) of the sun to the concerned rasi as well as on the convention followed in the particular region. As metioned earlier, four different conventions are followed, and these are described in some detail. ■

Table II : Starting dates (Gregorian) of the years of the four regional solar calendars, length of their years, and occurrence of 'leap' years in these calendars

Saka year : 1900 to 1916
Bengali San : 1385 to 1401
Kollam Year : 1154 to 1170

		Bengal School			Orissa School		Tamil School		Malayali School			
Sl No.	Saka year	Bengali San	Starting date	Year length	Starting date	Year length	Starting date	Year length	Kollam year	Saka year	Starting date	Year length
1.	1900	1385	15 Apr 78	365	13 Apr 78	366 @	14 Apr 78	365	1154	1900-01	17 Aug 78	365
2.	1901	1386	15 Apr 79	365	14 Apr 79	365	14 Apr 79	365	1155	1901-02	17 Aug 79	365
3.	1902	1387	14 Apr 80	365	13 Apr 80	365	13 Apr 80	366 @	1156	1902-03	16 Aug 80	366 @
4.	1903	1388	14 Apr 81	366 @	13 Apr 81	365	14 Apr 81	365	1157	1903-04	17 Aug 81	365
5.	1904	1389	15 Apr 82	365	13 Apr 82	366 @	14 Apr 82	365	1158	1904-05	17 Aug 82	365
6.	1905	1390	15 Apr 83	365	14 Apr 83	365	14 Apr 83	365	1159	1905-06	17 Aug 83	366 @
7.	1906	1391	14 Apr 84	365	13 Apr 84	365	13 Apr 84	366 @	1160	1906-07	17 Aug 84	365
8.	1907	1392	14 Apr 85	366 @	13 Apr 85	365	14 Apr 85	365	1161	1907-08	17 Aug 85	365
9.	1908	1393	15 Apr 86	365	13 Apr 86	366 @	14 Apr 86	365	1162	1908-09	17 Aug 86	365
10.	1909	1394	15 Apr 87	365	14 Apr 87	365	14 Apr 87	365	1163	1909-10	17 Aug 87	366 @
11.	1910	1395	14 Apr 88	365	13 Apr 88	365	13 Apr 88	366 @	1164	1910-11	17 Aug 88	365
12.	1911	1396	14 Apr 89	366 @	13 Apr 89	365	14 Apr 89	365	1165	1911-12	17 Aug 89	365
13.	1912	1397	15 Apr 90	365	13 Apr 90	366 @	14 Apr 90	365	1166	1912-13	17 Aug 90	365
14.	1913	1398	15 Apr 91	365	14 Apr 91	365	14 Apr 91	365	1167	1913-14	17 Aug 91	366 @
15.	1914	1399	14 Apr 92	365	13 Apr 92	365	13 Apr 92	366 @	1168	1914-15	17 Aug 92	365
16.	1915	1400	14 Apr 93	366 @	13 Apr 93	365	14 Apr 93	365	1169	1915-16	17 Aug 93	365
17.	1916	1401	15 Apr 94	365	13 Apr 94	366 @	14 Apr 94	365	1170	1916-17	17 Aug 94	365

Note : @ Occurrence of years of 366 days (leap years) in the four different regional calendars.

Note : The years of Bengal, Orissa and Tamil Schools start from Vaisakha while in Kerala its starts from Bhadra called there as Simha, and the era followed is Kollam. In Tamil School the first month corresponding to Vaisakha is named as Chittirai. The leap years occur normally at intervals of 4 years, and sometimes at an interval of 3 years (see Malayali School) so that generally 10 leap years occur in a period of 39 years.

Different Conventions for Starting Day of the Months

(a) Orissa School
(generally followed in Orissa, and also in Punjab and Haryana where solar calendar also is used)

The solar month begins on the same day when the sun enters the concerned rasi. Here, and so also in other cases mentioned below, day refers to the panchang or savana day, which is the period from a sun-rise to the next one.

(b) Tamil School
(generally followed in Tamil Nadu)

When samkranti, that is the ingress of the sun to the concerned rasi, takes place before sunset, the month begins on the same day. If it takes place after sunset, the month begins on the next day.

(c) Malayali School
(generally followed in Kerala)

Month begins on the same day if samkranti happens before aparahna, that is, before 3/5th duration of the day, which from sunrise to sunset of the concerned day, and this would be 1-12 P.M., if sunrise and sunset time are at 6 A.M. and 6 P.M. respectively; otherwise it begins on the next day.

(d) Bengal School
(generally followed in Bengal, Assam and Tripura)

When a samkranti takes place between sunrise and the following midnight, the solar month begins on the next day, and when it begins after midnight, the month begins on the day following the next day, that is, on the third day. This is the general rule, and in some special circumstances, there are some deviations from this rule.

For counting the days of the year and for other general purpose, the nirayana solar calendar based on (1) Orissa School is followed in Orissa and partially in Punjab, and Haryana; (2) Tamil School is followed in Tamil Nadu, and in the other Tamil speaking areas; (3) Malayali School is followed mainly in Kerala; and (4) Bengal School is followed generally in Bengal, Assam and Tripura. The years of these solar calendars, except that of kerala, start with the sun transisting into Mesha rasi. This transit time varies from year to year, and so also the exact length of the year calculated on this

basis. Further this time of transit determines the starting days of the years of the four different Schools and these days do not happen to be the same. Table III has been prepared showing the above particulars for the Saka years 1895 to 1917, and also the calculated mean length of the sidereal year from the exact length of the years, which will be interesting, and this has been placed on pages 16 & 17. ■

Table - III : Time of transit of the Sun to the sidereal or nirayana Mesha rasi, length of the years on transit time, and the starting day of the solar years as per four Schools followed in four different regions for years Saka 1894 to 1917 (1972 AD - 1995 AD)

(All dates as per Gregorian calendar)

Sr. No.	Year Saka Gregorian	Transit time of the Sun to nirayana Mesha rasi	Length of the nirayana year	Starting day of the year as per Four Schools			
				Bengal	Orissa	Tamil	Malayali
1	2	3	4	5	6	7	8
	Saka AD	h m	d h m				
1.	1894 (1972–73)	13 Apr 72 : 13–00	365 - 6 - 08	14 Apr 72	13 Apr 72	13 Apr 72	13 Apr 72
2.	1895 (1973–74)	13 Apr 73 : 19–08	365 - 6 - 15	14 Apr 73	13 Apr 73	14 Apr 73	14 Apr 73
3.	1896 (1974–75)	14 Apr 74 : 01–23	365 - 6 - 09	15 Apr 74	13 Apr 74	14 Apr 74	14 Apr 74
4.	1897 (1975-76)	14 Apr 75 : 07–32	365 - 6 - 10	15 Apr 75	14 Apr 75	14 Apr 75	14 Apr 75
5.	1898 (1976–77)	13 Apr 76 : 13–42	365 - 6 - 18	14 Apr 76	13 Apr 76	13 Apr 76	14 Apr 76
6.	1899 (1977–78)	13 Apr 77 : 20–00	365 - 6 - 07	14 Apr 77	13 Apr 77	14 Apr 77	14 Apr 77
7.	1900 (1978–79)	14 Apr 78 : 02–07	365 - 6 - 03	15 Apr 78	13 Apr 78	14 Apr 78	14 Apr 78
8.	1901 (1979–80)	14 Apr 79 : 08–10	365 - 6 - 11	15 Apr 79	14 Apr 79	14 Apr 79	14 Apr 79
9.	1902 (1980–81)	13 Apr 80 : 14–21	365 - 6 - 08	14 Apr 80	13 Apr 80	13 Apr 80	14 Apr 80
10.	1903 (1981–82)	13 Apr 81 : 20–29	365 - 6 - 13	14 Apr 81	13 Apr 81	14 Apr 81	14 Apr 81
11.	1904 (1982–83)	14 Apr 82 : 02–42	365 - 6 - 04	15 Apr 82	13 Apr 82	14 Apr 82	14 Apr 82
12.	1905 (1983–84)	14 Apr 83 : 08–46	365 - 6 - 03	15 Apr 83	14 Apr 83	14 Apr 83	14 Apr 83
13.	1906 (1984–85)	13 Apr 84 : 14–49	365 - 6 - 16	14 Apr 84	13 Apr 84	13 Apr 84	14 Apr 84
14.	1907 (1985–86)	13 Apr 85 : 21–05	365 - 6 - 07	14 Apr 85	13 Apr 85	14 Apr 85	14 Apr 85
15.	1908 (1986–87)	14 Apr 86 : 03–12	365 - 6 - 06	15 Apr 86	13 Apr 86	14 Apr 86	14 Apr 86
16.	1909 (1987–88)	14 Apr 87 : 09–18	365 - 6 - 16	15 apr 87	14 apr 87	14 APr 87	14 Apr 87
17.	1910 (1988–89)	13 Apr 88 : 15–34	365 - 6 - 11	14 Apr 88	13 Apr 88	13 Apr 88	14 Apr 88

Sr. No.	Year Saka Gregorian	Transit time of the Sun to nirayana Mesha rasi	Length of the nirayana year	Starting day of the year as per Four Schools			
				Bengal	Orissa	Tamil	Malayali
1	2	3	4	5	6	7	8
	Saka AD	h m	d h m				
18.	1911 (1989–90)	13 Apr 89 : 21–45	365 - 6 - 12	14 Apr 89	13 Apr 89	14 Apr 89	14 Apr 89
19.	1912 (1990–91)	14 Apr 90 : 03–57	365 - 6 - 07	15 Apr 90	13 Apr 90	14 Apr 90	14 Apr 90
20.	1913 (1991–92)	14 Apr 91 : 10–04	365 - 6 - 03	15 Apr 91	14 Apr 91	14 Apr 91	14 Apr 91
21.	1914 (1992–93)	13 Apr 92 : 16–07	365 - 6 - 18	14 Apr 92	13 Apr 92	13 Apr 92	14 Apr 92
22.	1915 (1993–94)	13 Apr 93 : 22–25	365 - 6 - 06	14 Apr 93	13 Apr 93	14 Apr 93	14 Apr 93
23.	1916 (1994–95)	14 Apr 94 : 04–31	365 - 6 - 00	15 Apr 94	13 Apr 94	14 Apr 94	14 Apr 94
24.	1917 (1995–96)	14 Apr 95 : 10–31	—	15 Apr 95	14 Apr 95	14 Apr 95	14 Apr 95

Note : 1. Kollam year of Malayali or Kerala solar calendar starts on the sun entering Simha rasi. However, as in other three Schools, the year starts on the sun entering Mesha rasi, the date shown under Malayali School is when the month Mesha of this calendar starts.

2. The mean year length calculated from Col. 4 works out as $365^d\ 6^h\ 9^m.17$ which is very close to the accepted mean value of $365^d\ 6^h\ 9^m.16$

A Standard All-India Calendar

(a) National Calendar Introduced in 1957

The different conventions followed by the regional calendars causing divergence between them, may be attributed to the past political divisions of the country and to some extent due to the cultural history of this large subcontinent. It has, however been felt for a long time by the elite, common people, and also by the Government that there should be a standard calendar for the whole of the country so that the days of the year are counted in a uniform manner in all regions. For this purpose the National Government formed after independence, appointed in November 1952, a Calendar Reform Committee under the Chairmanship of Prof. M.N. Saha, to recommend a uniform all-India calendar for the country. The Committee recommended a tropical or sayana year solar calendar for all-India civil use. They also recommended a tropical luni-solar calendar, that is, lunar calendar linked with a tropical solar year calendar, for religious and socio-religious purposes. In other words the Committee recommended abandoning the sidereal or nirayana system of calendar keeping, which has been in vogue for about a millenium and a half, and adopting instead a tropical system. The Government accepted the recommendation of the Calendar Reform Committee for adopting the tropical solar calendar as the uniform all-India calendar, and introduced it as a 'national' calendar w.e.f. 22 March 1957. The Government, however, did not accept the recommendation for adoption of the tropical luni-solar calendar, though the two calendars were interlinked. The use of tropical solar calendar would not have much meaning unless lunar calendar was also made tropical because it is taken that seasons with which festivals are based, are better linked with this calendar, and also that the Calendar Committee's main intention was to adopt the tropical system for celebration of festivals in the laid down seasons. The Government, however, felt that making such a drastic change in the religious calendric system, which would affect the age-old traditional system of fixiing the days of the festivals, would give rise to vehement protest by panchang makers and the people, and the change would not be accepted by most of them.

The starting day of the year of the solar tropical national calendar was made to be the day follwing the vernal equinox day, and the months had fixed number of days which broadly equalled the time taken by the sun to traverse the concerned tropical rasis, but their lengths were kept restricted to 31 days and 30 days. The names for the months of this different sayana or tropical year calendar, however, were kept the

same as those of the traditional nirayana calendar, and the 1st month, which starts from the day following vernal equinox day and is linked with tropical Aries, was named as Chaitra, followed by Vaisakha, Jyaishtha, etc. This similarity of names of months between two different types of calendars has been causing some confusion. The era adopted for this calendar was the traditional Saka era. But the year of occurrence of the leap years for this tropical-year national calendar was arranged to fall in the same leap-year of the Gregorian calendar with the idea that the relation of the dates between the two calendars remained the same. When leap year occurs, Chaitra would have 31 days. The name of the months of this introduced national calendar, their lengths, and the dates of the Gregorian calendar corresponding to the 1st day of its months are shown below :-

Name of months and their lengths	Gregorian date for 1st day of the month	Name of months and their lengths	Gregorian date for 1st day of the month
1. Chaitra (30) Chaitra (31) Leap year (λ)	22 March 21 March	7. Asvina (30)	23 September
		8. Kartika (30)	23 October
2. Vaisakha (31)	21 April	9. Agrahayana or Margasirsha (30)	22 November
3. Jyaishtha (31)	22 May		
4. Ashadha (31)	22 June	10. Pausha (30)	22 December
5. Sravana (31)	23 July	11. Magha (30)	21 January
6. Bhadra (31)	23 August	12. Phalguna (30)	20 February

The above national calendar being totally different from the traditional system of calendar keeping, did not find acceptance with the panchang makers of the country, who are de facto custodian of our traditional calendar, and also it did not make any impact on the people, and was not being used by them in any of their activities, inspite of the fact that it was introduced as early as 1957, and that the Government had been trying to propagate the use of this calendar through Rashtriya Panchangs which are being published in thirteen different languages of the country. At present, its use is found in governmental offices where after the date of the Gregorian calendar, the date of this calendar is shown as a non-consequential secondary calendar. In actual fact introduction of this new calendar, instead of raplacing all divergent calendars by one standard or uniform calendar, has added more confusion to the existing calendar keeping by adding one more calendar. This will be appreciated from the analysis made below showing how the same date of a month, say 1st. Kartika, 1918 Saka, indicates different days of the year of the Gregorian calendar :

	Name of the Calendar	Gregorian calendar date for 1st Kartika 1918, Saka
1.	Government's National Calendar	23 Oct 1996
2.	Solar Calendar of Bengal, Assam and Tripura	18 Oct 1996
3.	Solar Calendar of Orissa, and of Punjab & Haryana	16 Oct 1996
4.	Solar Calendar of Tamil Nadu	17 Oct 1996
5.	Solar Calendar of Kerala	17 Oct 1996
6.	Lunar Calendar of Maharashtra, Andhra, Karnataka, and Gujarat (Amanta Calendar)	12 Nov 1996
7.	Lunar Calendar of Uttar Pradesh, Bihar, Madhya Pradesh, Rajasthan, and Kashmir (Purnimanta Calendar)	27 Oct 1996

(b) A standard Calendar for all-India use recommended by Panchang Makers

The above state of affairs had been drawing the attention of the elite, calendric astronomers as well as that of the Government, and it was felt that the success of the national calendar in being used by the panchang makers and others in replacing divergent regional calendars should be reviewed. With this aim the Department of Science and Technology constituted in February, 1986, a Committee named as 'Review Committee on Indian Calendar and Positional Astronomy', with Prof. S.P. Pandya as Chairman and Commoder S.K. Chatterjee as convener. The terms of reference given to it so far the calendar was concerned, were 'to review the present status of the national calendar, its acceptance by panchang makers and others substituting other regional calendars in use, and to recommend necessary modifications to attain the objectives of a national calendar'. Keeping in view the above objective, a seminar of panchang makers, panchang pandits, calendric astronomers, and also of some members of the Review Committee was held in Bombay in January, 1987. At this Conference all present stressed the urgent necessity to have for the entire country a standard or uniform Indian calendar for all general use. This calendar would no doubt be solar, and its months would have fixed number of days, but it should be framed on broad nirayana principles, because such a pattern had been in use since the introduction of advanced siddhantic astronomy at about 400 AD or so. It would be unwise to overlook this view, and also the fact of general non-acceptance of sayana solar national calendar which was introduced about 30 years back in 1957. It was pointed out that Government itself had earlier rejected Calendar Reform Committee's recommendation to introduce sayana luni-solar calendar, and instead decided to support the popular demand to continue with the traditional nirayana one. The Conference resolved that if the all-India calendar was framed in the manner mentioned

below, it would be used by all panchang makers and would soon become popular :

(a) The year should start, as it is the general practice at present, from Vaisakha when the sun enters Mesha rasi which would be on 14 April or so.

(b) There would be no objection in the months having fixed number of days restricted to 31 and 30 days. This arrangement will tally with the time taken by the sun to traverse the nirayana rasis when rounded to whole number of days as will be seen from the analysis made in the Table IV below. Fortunately this fixed number of days proposed for the months of the all-India calendar are the same as those provided for the months of the same name of the national calendar. It was clarified that the above fixed days for the months would not affect in any way the present rule for determining, the time of Samkrantis, or the start of the lunar months, which will continue to be calculated on the exact time of transit of the sun to the rasis.

The 12 months and their number of days will be as follows : -

Table IV

Mean time taken by the Sun to traverse the twelve Rasis and the length of the corresponding linked twelve months when rounded to whole number of days

Sl. No.	Rasis	Corresponding Months	Time Taken by the Sun to traverse the *Rasis*/Months			Time Rounded to Whole Number of Days
			Days	Hours	Minutes	
(1)	(2)	(3)	(4)			(5)
1.	*Mesha*	*Vaisakha*	30	20	53	31
2.	*Vrisha*	*Jyaishtha*	31	6	37	31
3.	*Mithuna*	*Ashadha*	31	10	53	31
4.	*Karkata*	*Sravana*	31	8	23	31
5.	*Simha*	*Bhadra*	30	23	55	31
6.	*Kanya*	*Asvina*	30	11	56	30
7.	*Tula*	*Kartika*	29	23	49	30
8.	*Vrischika*	*Agrahayana*	29	14	40	30
9.	*Dhanus*	*Pausha*	29	10	45	30
10.	*Makara*	*Magha*	29	12	59	30
11.	*Kumbha*	*Phalguna*	29	20	51	30
12	*Mina*	*Chaitra*	30	8	28	30
		Total	365	6	9	365

31 days

(1) Vaisakha (Mesha), (2) Jyaishtha (Vrisha), (3) Ashadha (Mithuna),
(4) Sravana (Karkata), (5) Bhadra (Simha)

30 days

(6) Asvina (Kanya), (7) Kartika (Tula), (8) Agrahayana or Margasirsha (Vrischika),
(9) Pausha (Dhanus), (10) Magha (Makara), (11) Phalguna (Kumbha), and
(12) Chaitra (Mina).

(c) The length of the year may be taken as 365.256363 days, but the normal year will have 365 days. To cater for the remaining 0.256363 day, there will be leap years at four year intervals including all century years, and also additional leap years at 160 year intervals. In leap years, Chaitra will have 31 days.

(d) An era has to be chosen for a calendar. The era preferred for this all-India calendar was Kali era, which is non-regional in character, and whose epoch is midnight 17/18 February – 3101 AD, and would normally cover without the system of minus dating, the past eventful period of Indian history. Normal and additional leap years will be counted on the basis of the years of Kali era. Regional eras may continue to be shown, if desired.

If the aforesaid modifications are carried out to the national calendar, the difference in the number of days between the start of the months of the same name of the two calendars would be only 7 days, and as such there would not be much impact in making this change-over, and more so, when the national calendar is not much in use. Table V placed at page 23 shows the close similarity between the present national calendar and the proposed all-India calendar, and Table VI placed at pages 24 to 27 shows the relationship of the days of the months of the all-India calendar with those of the Gregorian calendar. To compare further these two calendars, a star Chart, marked as Diagram IV, has been placed at page 28, depicting the disposition of the rasis and the linked months of the two calendars on the ecliptic against the background star constellations. In this chart, for ease of illustrating properly the rasis and the linked months, the ecliptic has been shown as a straight line and the equator as a sinusoidal curve. It will be noticed that in April, 1997 the initial point of the sayana national calendar was placed at 23° 49' away on the west from that of the nirayana traditional sloar calendar, and this differnence has been constantly increasing due to recession of the equinoxes. This fact makes the zodiac signs or rasis of the tropical calendar not to have any permanent relation with the star constellations of the same name as that of the Signs. As a matter of fact, as mentioned much earlier, the 1st point of Aries of the tropical calendar has now moved to the area marked for Pisces constellation, while that of the nirayana calendar has remained in the same position in the Aries constellation. This Star Chart shows the twelve zodiac or rasi constellations and also other prominent ones, and on it has been marked the names of important

Table V : Comparison between the present National Calendar and the proposed all-India Calendar showing their close similarity

Saha Committee's solar calendar introduced as a National Calendar				Proposed all-India Calendar by slightly modifying the present National Calendar as suggested by panchang makers and pandits			
Sl. No. from 1st month	Name of months	Number of days in the months	Gregorian date for 1st day of the month	Sl. No. from 1st month	Name of Months	Number of days in the months	Gregorian date for 1st day of the month (normal years)
1.	Chaitra **	30 (31 in leap years)	22 March (21 March in leap years)	12.	Chaitra	30 (31 in leap years)	15 March
2.	Vaisakha	31	21 April	1.	Vaisakha **	31	14 April
3.	Jyaishtha	31	22 May	2.	Jyaishtha	31	15 May
4.	Ashadha	31	22 June	3.	Ashadha	31	15 June
5.	Sravana	31	23 July	4.	Sravana	31	16 July
6.	Bhadra	31	23 August	5.	Bhadra	31	16 August
7.	Asvina	30	23 September	6.	Asvina	30	16 September
8.	Kartika	30	23 October	7.	Kartiaka	30	16 October
9.	Margasirsha or Aghrahayana	30	22 November	8.	Margasirsha or Agrahayana	30	15 November
10.	Pausha	30	22 December	9.	Pausha	30	15 December
11.	Magha	30	21 January	10.	Magha	30	14 January
12.	Phalguna	30	20 February	11.	Phalguna	30	13 February

NOTE:

Era adopted is 'Saka' whose epoch starts 78 years after Christian era. The Saka era year 1919 corresponds to 1997 - 98 A.D.

Leap years occur in the same years as those in the Gregorian calendar when the year has 366 days. This means that after adding 78 to Saka year, if the sum is divisible by 4, then it is a leap year. But when the sum becomes multiple of 100, it would not be a leap year unless it is divisible by 400.

** First month of the year

NOTE :

a) Era to be followed will be Kali era whose eppoch is 3102 B.C. or −3101A.D. Kali era year 5098 corresponds to 1997-98 A.D. or Saka 1919

b) Leap years will occur in Kali years divisible by 4. Sidereal or nirayana year being a little longer, an additional leap year will occur at intervals of 160 years or so.

c) The 1st point of Aries of niyayana zodiac was about 23° 49' ahead from 1st point sayana or tropical zodiac, that is from vernal equinoctial point, on 1st Vaisakha, 5098 Kali; or 14 April 1997.

Table VI: (A) Days of the months of a non-leap year of Standard all-India Calendar, and the corresponding days of the Gregorian calendar shown in brackets under each day

WEEK DAYS	VAISAKHA - 31d (APR-MAY)					JYAISTHA - 31d (MAY-JUNE)				
SUNDAY		7 (20)	14 (27)	21 (4)	28 (11)	-	4 (18)	11 (25)	18 (1 June)	25 (8)
MONDAY	1 (14 Apr)	8 (21)	15 (28)	22 (5)	29 (12)	-	5 (19)	12 (26)	19 (2)	26 (9)
TUESDAY	2 (15)	9 (22)	16 (29)	23 (6)	30 (13)	-	6 (20)	13 (27)	20 (3)	27 (10)
WEDNESDAY	3 (16)	10 (23)	17 (30)	24 (7)	31 (14)	-	7 (21)	14 (28)	21 (4)	28 (11)
THURSDAY	4 (17)	11 (24)	18 (1 May)	25 (8)	- -	1 (15)	8 (22)	15 (29)	22 (5)	29 (12)
FRIDAY	5 (18)	12 (25)	19 (2)	26 (9)	-	2 (16)	9 (23)	16 (30)	23 (6)	30 (13)
SATURDAY	6 (19)	13 (26)	20 (3)	27 (10)	-	3 (17)	10 (24)	17 (31)	24 (7)	31 (14)

	ASHADHA - 31d (JUNE-JULY)					SRAVANA - 31d (JULY-AUG)				
SUNDAY	1 (15)	8 (22)	15 (29)	22 (6)	29 (13)	-	5 (20)	12 (27)	19 (3)	26 (10)
MONDAY	2 (16)	9 (23)	16 (30)	23 (7)	30 (14)	-	6 (21)	13 (28)	20 (4)	27 (11)
TUESDAY	3 (17)	10 (24)	17 (1 Jul	24 (8)	31 (15)	-	7 (22)	14 (29)	21 (5)	28 (12)
WEDNESDAY	4 (18)	11 (25)	18 (2)	25 (9)	-	1 (16)	8 (23)	156 (30)	22 (6)	29 (13)
THURSDAY	5 (19)	12 (26)	19 (3)	26 (10)	-	2 (17)	9 (24)	16 (31)	23 (7)	30 (14)
FRIDAY	6 (20)	13 (27)	20 (4)	27 (11)	-	3 (18)	10 (25)	17 (1 Aug)	24 (8)	31 (15)
SATURDAY	7 (21)	14 (28)	21 (5)	28 (12)	-	4 (19)	11 (26)	18 (2)	25 (9)	- -

WEEK DAYS	BHADRA - 31d (Aug-Sept)					ASVINA - 30d (Sept-Oct)				
SUNDAY	30 (14)	2 (17)	9 (24)	16 (31)	23 (7)	-	6 (21)	13 (28)	20 (5)	27 (12)
MONDAY	31 (15)	3 (18)	10 (25)	17 (1 Sept)	24 (8)	-	7 (22)	14 (29)	21 (6)	28 (13)
TUESDAY	-	4 (19)	11 (26)	18 (2)	25 (9)	1 (16)	8 (23)	15 (30)	22 (7)	29 (14)
WEDNESDAY	-	5 (20)	12 (27)	19 (3)	26 (10)	2 (17)	9 (24)	16 (1 Oct)	23 (8)	30 (15)
THURSDAY	-	6 (21)	13 (28)	20 (4)	27 (11)	3 (18)	10 (25)	17 (2)	24 (9)	
FRIDAY	-	7 (22)	14 (29)	21 (5)	28 (12)	4 (19)	11 (26)	18 (3)	25 (10)	
SATURDAY	1 (16 Aug)	8 (23)	15 (30)	22 (6)	29 (13)	5 (20)	12 (27)	19 (4)	26 (11)	

	KARTIKA - 30d (Oct-Nov)					AGRAHAYANA OR MARGASIRSHA - 30d (Nov-Dec)				
SUNDAY	-	4 (19)	11 (26)	18 (2)	25 (9)	30 (14)	2 (16)	9 (23)	16 (30)	23 (7)
MONDAY	-	5 (20)	12 (27)	19 (3)	26 (10)	-	3 (17)	10 (24)	17 (1 Dec)	24 (8)
TUESDAY	-	6 (21)	13 (28)	20 (4)	27 (11)	-	4 (18)	11 (25)	18 (2)	25 (9)
WEDNESDAY	-	7 (22)	14 (29)	21 (5)	28 (12)	-	5 (19)	12 (26)	19 (3)	26 (10)
THURSDAY	1 (16)	8 (23)	15 (30)	22 (6)	29 (13)	-	6 (20)	13 (27)	20 (4)	27 (11)
FRIDAY	2 (17)	9 (24)	16 (31)	23 (7)	30 (14)	-	7 (21)	14 (28)	21 (5)	28 (12)
SATURDAY	3 (18)	10 (25)	17 (1 Nov)	24 (8)	-	1 (15)	8 (22)	15 (29)	22 (60	29 (13)

WEEK DAYS	PAUSHA - 30d (Dec - Jan)					MAGHA - 30d (Jan - Feb)				
SUNDAY	-	7 (21)	14 (28)	21 (4)	28 (11)	-	5 (18)	12 (25)	19 (1 Feb)	26 (8)
MONDAY	1 (15 Dec)	8 (22)	15 (29)	22 (5)	29 (12)	-	6 (19)	13 (26)	20 (2)	27 (9)
TUESDAY	2 (16)	9 (23)	16 (30)	23 (6)	30 (13)	-	7 (20)	14 (27)	21 (3)	28 (10)
WEDNESDAY	3 (17)	10 (24)	17 (31)	24 (7)	-	1 (14)	8 (21)	15 (28)	22 (4)	29 (11)
THURSDAY	4 (18)	11 (25)	18 (1 Jan)	25 (8)	-	2 (15)	9 (22)	16 (29)	23 (5)	30 (12)
FRIDAY	5 (19)	12 (26)	19 (2)	26 (9)	-	3 (16)	10 (23)	17 (30)	24 (6)	-
SATURDAY	6 (20)	13 (27)	20 (3)	27 (10)	-	4 (17)	11 (24)	18 (31)	25 (7)	-

	PHALGUNA - 30d (Feb-Mar)					CHAITRA - 30d (Mar - Apr)				
SUNDAY	-	3 (15)	10 (22)	17 (1 Mar)	24 (8)	1 (15)	8 (22)	15 (29)	22 (5)	29 (12)
MONDAY	-	4 (16)	11 (23)	18 (2)	25 (9)	2 (16)	9 (23)	16 (30)	23 (6)	30 (13)
TUESDAY	-	5 (17)	12 (24)	19 (3)	26 (10)	3 (17)	10 (24)	17 (31)	24 (7)	-
WEDNESDAY	-	6 (18)	13 (25)	20 (4)	27 (11)	4 (18)	11 (25)	18 (1 Apr)	25 (8)	-
THURSDAY	-	7 (19)	14 (26)	21 (5)	28 (12)	5 (19)	12 (26)	19 (2)	26 (9)	-
Friday	1 (13 Feb)	8 (20)	15 (27)	22 (6)	29 (13)	6 (20)	13 (27)	20 (3)	27 (10)	-
SATURDAY	2 (14)	9 (21)	16 (28)	23 (7)	30 (14)	7 (21)	14 (28)	21 (4)	28 (11)	-

(B) Days of months of a leap-year of the Standard all-India Calendar, and the corresponding days of the Gregorian calendar shown in brackets under each day

It so happens that the leap-month February of the leap year of the Gregorian calendar falls in the leap year of the Standard all-India Calendar which is calculated on the basis of Kali year. For example, Kali 5096 was a leap year for the all-India calendar, and this covers the period of the Gregorian calendar from mid-April 1995 to mid-April 1996 AD, where 1996 AD was a leap year. The month of Phalguna covers 2nd half of the February and 1st half of March, and so the leap month February having an extra day ends in Phalguna. Hence the change in relationship between the dates of the all-India calendar and Gregorian calendar happens only for the months of Phalguna and Chaitra as compared to the preceeding Table (A). Therefore, in this Table the relationship between the days of the Standard all-India calendar and the Gregorian calendar during the occurrence of leap year is shown only for the aforesaid two months of Phalguna and Chaitra.

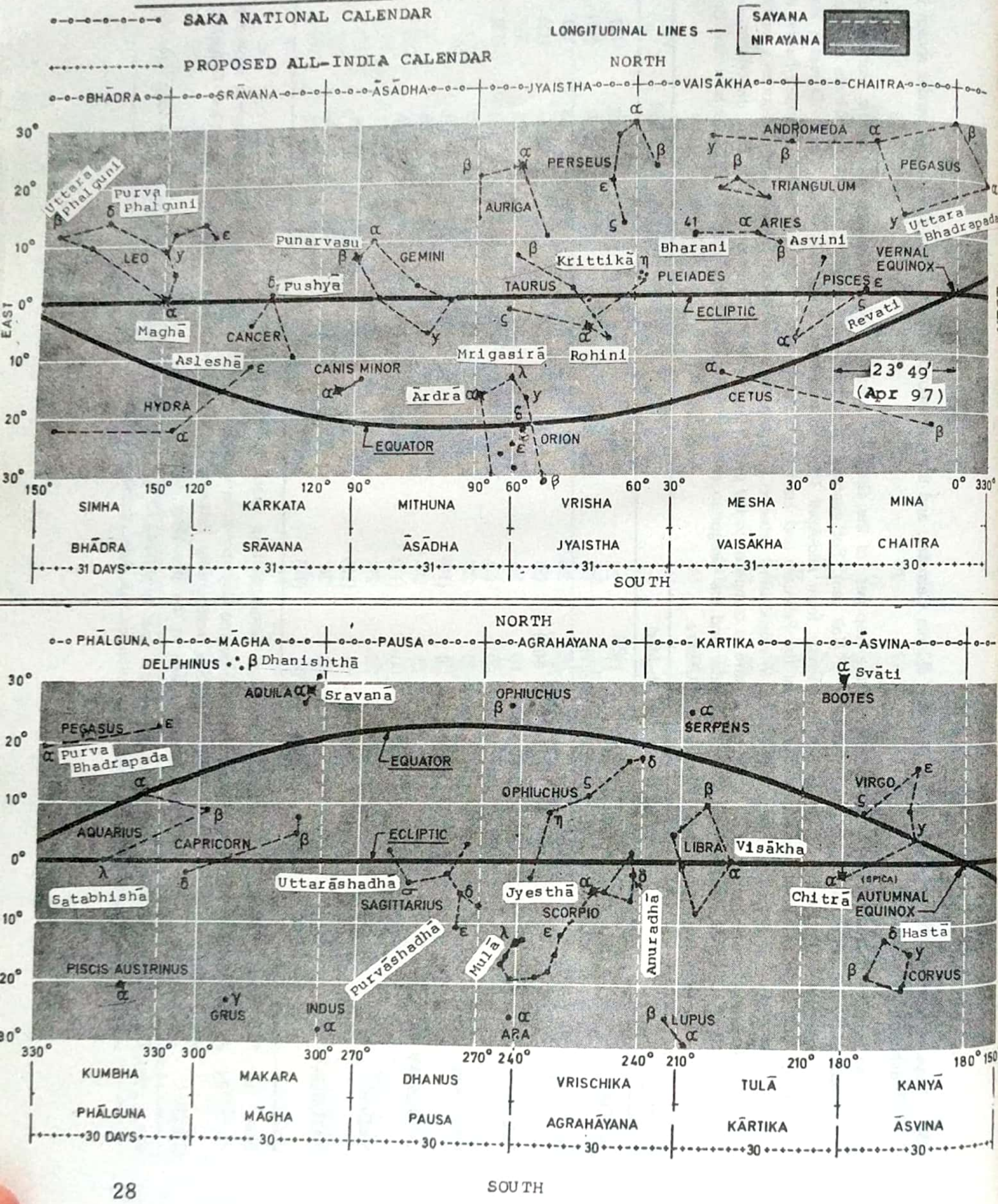
WEEK DAYS	PHALGUNA - 30d (Feb-Mar)					CHAITRA - 31d* (Mar-Apr)				
SUNDAY	-	3 (15)	10 (22)	17 (29)	24 (7)	1 (14 Mar)	8 (21)	15 (28)	22 (4)	29 (11)
MONDAY	-	4 (16)	11 (23)	18 (1 Mar)	25 (8)	2 (15)	9 (22)	16 (29)	23 (5)	30 (12)
TUESDAY	-	5 (17)	12 (24)	19 (2)	26 (9)	3 (16)	10 (23)	17 (30)	24 (6)	31* (13)
Wednesday	-	6 (18)	13 (25)	20 (3)	27 (10)	4 (17)	11 (24)	18 (31)	25 (7)	-
THURSDAY	-	7 (19)	14 (26)	21 (4)	28 (11)	5 (18)	12 (25)	19 (1 Apr)	26 (8)	-
FRIDAY	1 (13 Feb)	8 (20)	15 (27)	22 (5)	29 (12)	6 (19)	13 (26)	20 (2)	27 (9)	-
SATURDAY	2 (14)	9 (21)	16 (28)	23 (6)	30 (13)	7 (20)	14 (27)	21 (3)	28 (10)	-

Note : (a) *As Chaitra has been chosen to be the leap month in leap years, it has an extra day,

(b) As an alternative, Phalguna may be chosen to be the leap month in leap years. In that case the advantage will be that excepting last 14 days or so of the month of Phalguna, relationship between the days of the months of the all-India and Gregorian calendars will remain the same as that shown in the preceding Table (A).

c) The sidereal year being longer than the tropical year by 0.014173 day, the year of the sidereal calendar at some long intervals, will start one day later progressively in relation to the date of the Gregorian calendar.

Diagram IV : P..ationship between the months of Saka National Calendar and proposed All-India Calendar, and theirs with Rasis or Zodiacal signs depicted against background stars.



and also other prominent ones, and on it has been marked the names of important stars as per modern astronomical chart. It may be noted that the zodiac belt, apart from being divided into 12 equal rasis, is also divided into 27 equal nakshatra divisions or nakshatras from the same initial point, and each of these divisions is named against a prominent or some traditionally known star found in the lune of that division, or close to it. (See Nakshatra discussed in detail on page 52). These stars are known as junction stars or yogataras. To identify these 27 stars, their Indian names and corresponding astronomical designations are given below, and these Indian names of the stars have also been marked on the Chart.

Sl. No. and name of Star	Astronomical designation of the Star	Sl. No. and name of Star	Astronomical designation of the Star
1. Asvini	β Arieties	14. Chitra	∝ Virgins
2. Bharani	41 Arieties	15. Svati	∝ Bootis
3. Krittika	η Tauri	16. Visakha	∝ Librae
4. Rohini	∝ Tauri	17. Anuradha	δ Scorpii
5. Mrigasira	λ Orionis	18. Jyestha	∝ Scorpii
6. Ardra	∝ Orionis	19. Mula	λ Scorpii
7. Punarvasu	β Geminiorum	20. Purvashadha	δ Sagittarii
8. Pushya	δ Cancri	21. Uttarashadha	σ Sagittari
9. Aslesha	ε Hydrae	22. Sravana	∝ Aquilae
10. Magha	∝ Leonis	23. Dhanishtha	β Delphini
		24. Satabhisha	λ Aquaric
11. Purva Phalguni	δ Leonis	25. Purva Bhadrapada	∝ Pegasi
12. Uttara Phalguni	β Leonis	26. Uttara Bhadrapada	γ Pegasi
13. Hasta	δ Corvi	27. Revati	ς Piscium

It may be remembered that the basic difference between the sidereal (nirayana) and tropical (sayana) calendars is in the length of their years. This is manifested in the larger number of leap years provided in the sidereal year calendar having fixed number of days for months than those provided for a tropical year calendar. If at any time the occurrence of number of leap years in a sidereal calendar is made equal to those in the tropical calendar, the former calendar would then automatically convert itself into the latter type. So change over from one type to another is very simple.

The Review Committee, however, at their meetings held in April and September, 1987, considered the recommendations made at the Bombay seminar of panchang pandits held in January, 1987, and after considerable discussion, resolved on a majority

opinion that the present national calendar be given a further trial of five years, and after this period the matter be reviewed by another experts' committee.

Not much change had happened on the expected use of the national calendar since the adoption of the above resolution in 1987, and the position had remained as before. There has been, however, a growing demand in the country to resolve this long outstanding national problem. This matter of national importance was taken up by Maharshi Sandipani Rashtriya Veda Vidya Pratisthanam in collaboration with Shri Lal Bahadur Shastri Rashtriya Sanskrit Vidyapeetha, New Delhi, both of them functioning under the Ministry of Human Resource Development, and an all-India conference of panchang makers, panchang pandits, calendric astronomers and others was arranged by them in April 1994, at New Delhi, where this question of bringing into one of generally acceptable all-India calendar was thoroughly discussed. It was unanimously resolved at this conference that it was an urgent national necessity to have a uniform or standard all-India calendar, and calendar unanimously recommended by them for this purpose happened to be the same as that proposed earlier at the Bombay conference of panchang pandits in January, 1987. It is anticipated that this recommended all-India calendar will come into use in a short period of time and also that the Central Government would take action early to introduce this accepted calendar as the national calendar.

■

Lunar Calendar, or Luni-solar Calendar

Amanta calendar, also known as 'Mukhyamana'

The basic unit of the lunar calendar is the lunar month which is the time interval from one new moon to the next, or alternatively, from one full moon to the next. The lunar month counted from new moon to new moon is known as amanta, and the lunar calendar based on this month is known as amanta calendar. When the month is counted from full moon to full moon, it is known as purnimanta, and the calendar is called purnimanta calendar, and this latter type has been described later. The amanta month is also called mukhyamana, specially in the north, because even where purnimanta calendar is followed, days of festivals are normally fixed on the basis of amanta months. The months of amanta lunar calendar are named after the solar months in which the new moon (same as the ending moment of amavasya, that is, amanta) from which this month starts, falls. For the purpose of reckoning lunar months, the solar months are taken to cover the time period from the exact moment of the transit of the sun to the concerned rasi to the exact moment of its transit to the next rasi. For example, the solar month of Chaitra is reckoned to cover the time that may be taken by the sun from the time of transit to the first point of Mina rasi to the time taken to the transit to be first point of Mesha rasi. The amanta lunar month, it will be observed, may begin on any day of the solar month. Amanta lunar calendar starts from Chaitra, unlike the solar which starts from Vaisakha, and ends with Phalguna.

The months are divided into two parts - sukla paksha (bright half month), covering the time period from the new móon (end of amavasya) to the next full moon (end of purnima), and Krishna paksha, (dark half month), covering the period from full moon to the next new moon. The sukla paksha half is also some times called as 'Sudi' and the krishna paksha half as 'Vadi'.

As mentioned earlier, the lunar months are named after the solar months in which the initial new moon of the lunar month occurs. The amanta lunar year starts from the month of Chaitra from the occurrence of new moon in the solar month of the same name. The solar year, on the other hand, starts from Vaisakha on the sun entring nirayana Mesha rasi. The twelve months of the lunar year which are named after solar months and starts from Chaitra are as follows :-

1. Chaitra,	2. Vaisaka	3. Jyaishtha,
4. Ashadha,	5. Sravana,	6. Bhadra,
7. Asvina,	8. Kartika,	9. Agrahayana or Margasirsha
10. Pausha,	11. Magha	12. Phalguna.

As the lunar year is shorter than the solar, and is kept adjusted to the latter by the addition of intercalary months at intervals, the starting day of the lunar year in relation to the day of the year of solar calendar like that of the Gregorian, will differ from year to year, and will oscillate between the days of the months of March and April, remembering that solar Chaitra generally covers the period from 15 March to 13 April. The Chart below shows the oscillation of the starting day of the lunar years which is generally the 1st day of Chaitra, in the Saka year 1913 to 1919 :

Sr. No.	Saka year	Starting day of Chaitradi lunar year as per Gregorian calendar	Period when adhika months occured
1.	1913	17 March 91	15 Apr to 14 May
2.	1914	4 April 92	--
3.	1915	24 March 93	18 Aug to 15 Sept
4.	1916	12 April 94	--
5.	1917	1 April 95	--
6.	1918	20 March 96	17 Jun to 15 July
7.	1919	8 April 97	--

The amanta or mukhyamana lunar calendar is mainly followed in the states of Karnataka, Andhra, Maharashtra, and Gujarat. Also in the states where solar calendar is followed like that of Assam, Bengal, Orissa, Tamil Nadu etc, amanta lunar calendar is used for determining the dates of various religious and socio-religious festivals, ceremonies, and related matters. In Gujarat and parts of Rajasthan, however the lunar year starts from the month of Kartika with the end of Diwali amavasya and the start of sukla pratipada of that month. In Kutch and parts of Kathiawar again, the lunar year starts from Ashadha sukla partipada.

Tithi

Tithi is the most important item in the Indian lunar calendar. It is the period of time during which the moon gains successively 12° or its integral multiples on the sun, there being thus 30 tithis, of which 15 are sukla paksha (bright half) and 15 are krishna paksha (dark half). Tithis of each paksha (half of lunar month) are serially numbered 1 to 15, designated by the prifix 'S' for sukla paksha and 'K' for krinshna paksha. Name of the fifteen tithis along with their serial number is as follows :-

(S)	(K)	1.	Pratipada	(S)	(K)	8.	Ashtami
(S)	(K)	2.	Dvitiya	(S)	(K)	9.	Navami
(S)	(K)	3.	Tritiya	(S)	(K)	10.	Dasami
(S)	(K)	4.	Chaturthi	(S)	(K)	11.	Ekadasi
(S)	(K)	5.	Panchami	(S)	(K)	12.	Dvadasi
(S)	(K)	6.	Sashthi	(S)	(K)	13.	Trayodasi
(S)	(K)	7.	Saptami	(S)	(K)	14.	Chaturdasi
					S	15	Purnima
					K	30	Amavasya

The days of the months of the lunar calendar are numbered in accordance with the serial number of the tithi prevailing at sunrise. This means that when it is said that the day is Asvina sukla divitiya, or Kartika krishna tritiya, the astronomical position is that at sunrise time, in the first case it was second or dvitya tithi of sukla paksha (bright half) of the lunar month of Asvina. Similarly, in the second case it was third or tritiya tithi of krishna paksha (dark half) of the lunar month of Kartika. As the motion of the moon is not steady, the duration of a tithi may very from 26.78 hours to 19.98 hours, and this sometimes results in a tithi period covering two successive sunrises, or falling between these, that is covering no sunrise. When this happens there is a break in the seriality in counting the days of the lunar month because in the first case the serial number of the day will be repeated, and in the second case it will be omitted. For example, say when tritiya tithi covers two consecutive sunrises, then the days of the lunar month will be numbered as 1, 2, 3, 3, 4, etc. When the same tithi fall between two sunrises, that is, it does not cover any sunrise, then the month-days will have number 1, 2, 4, 5, etc. This is no doubt unsatisfactory for using lunar calendar as a civil calendar apart from other complications of having intercalary months which has been elaborated below.

Occurrence of intercalary or adhika month, and also of kshaya month in the luni-solar calendar

Adhika or Mala month

The mean duration of a lunar month is 29.5306 days, and hence the length of a lunar year comprising of 12 such months equals 354.3672 days. Thus it falls short of sidereal or nirayana solar year by about 10.89 days, and that of the tropical solar year by about 10.87 days. Therefore to keep the lunar year adjusted to the solar, and consequently to keep the lunar months linked with the solar months and thus with the seasons, an intercalary lunar month has to be added to the lunar year at intervals. This addition is generally done in a manner that 7 intercalary lunar months are added in each cycle of 19 lunar years so that the total length of this cyclic lunar period equals 19 solar years. The mathematics of this is as follows : 19 lunar years with 7 intercalary lunar months equal (19 X 12 + 7) X 29.5306 = 6939.69 days. The number of days in 19 sidereal solar years equal 19 X 365.256363 days = 6939.87 days. In case of

tropical year, 19 such years equal 19 X 365.24219 days = 6939.60 days. Hence the correction made by the above method maintains the link between the lunar and solar calendars. This type of calendar therefore, is called luni-solar. It will be observered that an intercalary month is required to be added at an average period of 19/7 = 2.7 years.

This 19-year cycle is generally known as 'Metonic Cycle', named after the Greek astronomer 'Meton', though it is believed that this method of correction to the lunar calendar was applied earlier by Chaldean astronomers. Hebrew luni-solar calendar used in Israel follows the above Metonic method for correcting their traditional luni-solar calendar where an intercalary month is added in the 19 year cycle in the 3rd, 6th, 8th, 11th, 14th, 17th and 19th year after the 5th month 'Shebat', and it is called as Adar I (Adar elf), while the normal month is called Adar II (Adar bet), which comes immediately after the aforesaid intercalary month. There are also other countries which follow Metonic system of adding intercalary lunar months.

The Indian luni-solar calendar, however, does not follow the above system of adding an intercalary month in a mechanical manner on a fixed time schedule. The Indian astronomers devised an ingenious method of adding an intercalary month based on the true motions of the sun and the moon. According to this method when two new moons occur within one solar month, which for this purpose is reckoned to be the exact time period from the entry of the sun (Samkranti) to the concerned rasi to the entry of the sun to the next rasi, then as per laid down rule, two lunar months occur having the same name designation as that of the solar month. The first lunar month commencing from the first new moon is prefixed with the title 'adhika' or 'mala' and is considered as an intercalary month, and the second one starting from the next new moon is prefiexed with the title 'suddha', and this latter month is considered to be true or normal month. Mala month is omitted for fixiing any religious or socio-religious festivals and ceremonies except for the ceremonies concerning death and birth which cannot await postponement. Under the above device intercalary months occur generally at intervals of 2 years 11 months, 2 years 10 months and 2 years 4 montths in a manner that the average time interval works out nearly as 2.7 years which is the average time interval for occurrence of such months. Diagram V at page 35 illustrates how adjustment is made by intercalary months, and the Table VII at page 36 shows the time intervals of occurrence of these intercalary or adhika months from 1947 to 1999 AD (Saka 1869 to 1921).

Kshaya month

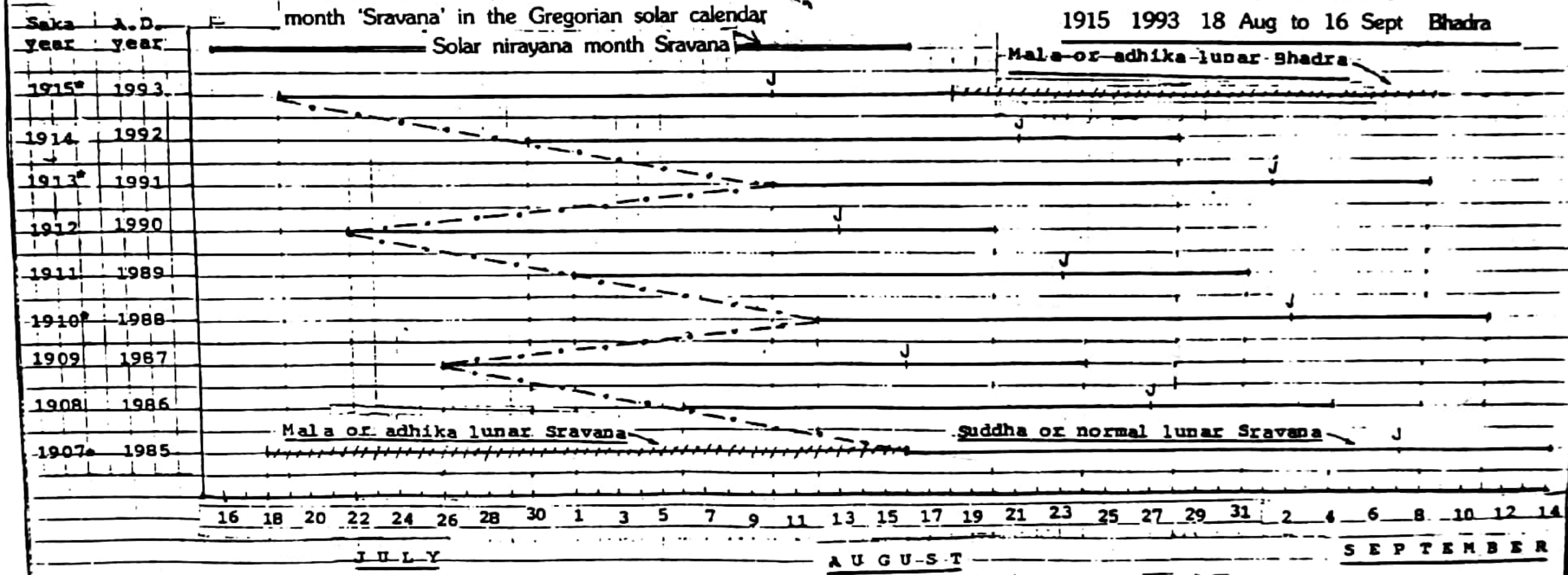
It may, however, sometimes happen, which may be as close as 19 years or as long as 141 years, and also at intermediate intervals of 46, 65, 76 and 122 years, that a lunar month may completely overlap any of the short three nirayana solar months of Agrahayana, (also known as Margasirsha), Pausha, Magha. In that case, no new moon will occux in that overlapped solar month, and as such under the normal system of reckoning, there would be no lunar month after the name of this solar month, and thus there would be a missing or 'kshaya' lunar month in that lunar year.

Diagram V : Diagram illustrates by the example of lunar month Sravana, how lunar months occur earlier in each successive year in relation to the linked solar months, and how this trend is kept corrected by the provision of adhika months at intervals between two and three years, and how this causes oscillation of the date of the beginning of the months and consequently also the date of lunar festivals in relation to the solar calendar as shown by the example of Janmashtami festival in years 1907 to 1915 Saka

Occurrence of adhika or mala months from 1907 to 1915 Saka, or 1985 to 1993 A.D.

Saka Year	A.D. Year	Gregorian Date	Mala months
1907	1985	18 July to 16 Aug	Sravana
1910	1988	16 May to 14 June	Jyaishtha
1913	1991	15 Apr to 14 May	Vaisakha
1915	1993	18 Aug to 16 Sept	Bhadra

Firm lines indicate the period covered by the amanta lunar month 'Sravana' in the Gregorian solar calendar



—·—·— shows the oscillaton of 1st. day of lunar month in relation to the linked solar month.

* Year in which an adhika month has occurred

'J' means the date for celebration of Janmashtami

Table VII : Year and time intervals of occurrence of adhika (mala or intercalary) months, and also of kshaya months in the period Saka 1869 to 1921 (Vikram 2004 to 2056; Gregorian 1947 to 1999)

Sl No	Gregorian year	Saka year	Name of adhika months	Interval of occurrence of adhika months		Remarks
1	2	3	4	5		6
				Year	Month	
1	1947	1869	Sravana	2	4	
2	1950	1872	Ashadha	2	11	
3	1953	1875	Vaisakha	2	10	
4	1955	1877	Bhadra	2	4	
5	1958	1880	Sravana	2	11	
6	1961	1883	Jyaishtha	2	10	
7	1963 }	1885	Kartika @ }	2	4	Margasirsha is kshaya month. Time interval of occurrence of the two associated adhika months is from previous Jyaistha (Sl. 6)
7 A	1964		Chaitra	2	10	
8	1966	1888	Sravana	2	10	
9	1969	1891	Ashadha	2	11	
10	1972	1894	Vaisakha	2	10	
11	1974	1896	Bhadra	2	4	
12	1977	1899	Sravana @@	2	10	
13	1980	1902	Jyaishtha	2	10	
14	1982 }	1904	Asvina	2 }	4	Magha is kshaya month. Time interval of occurrence of the two associated adhika months is from previous Jyaistha (Sl. 13)
14 A	1983		Phalguna	2	9	
15	1985	1907	Sravana	2	10	Time interval is from first adhika month at Sl. 14.
16	1988	1910	Jyaishtha	2	10	
17	1991	1913	Vaisakha	2	11	
18	1993	1915	Bhadra	2	4	
19	1996	1918	Ashadha	2	10	
20	1999	1921	Jyaishtha	2	11	
21	2001	1923	Asvina	2	4	

@ Asvina is adhika, and Pausha is kshaya as per Surya Siddhanta school.

@@ Ashadha as per Surya Siddanta School

Note : (a) Normally at long intervals, which may be as close as 19 years and as far off as 141 years, when a kshaya month occurs in a lunar year an exceptional situation takes place by the occurrence of two adhika months in that period, one before and one after the kshaya month, and this had happened in Saka years 1885 and 1904, vide Serial No. 7 & 7A and 14 & 14A.

(b) It will be observed that seven adhika months have been occuring in cycles of 19 years as required. Again in succeeding 19-year blocks, adhika months have been happening generally in a uniform manner.

However, when such kshaya month happens in a lunar year, there always occur two adhika lunar months in that period, one before and one after the lunar month that has overlapped the solar month. One of the two adhika months is treated as an intercalary month, and the other adhika month is treated as true month compensating for the missing lunar month, and thus restoring the normal 12 month structure of the lunar year.

Table VIII placed at page 38 gives a list of the kshaya months along with the two accompanying adhika months that have occurred in the period 448 Saka (526-27AD) to 1904 Saka (1982-83AD), the last one being the latest one.

Diagram VI below illustrates the occurrence of the kshaya month and two associated adhika months in the Saka year 1904 (1982-83 AD).

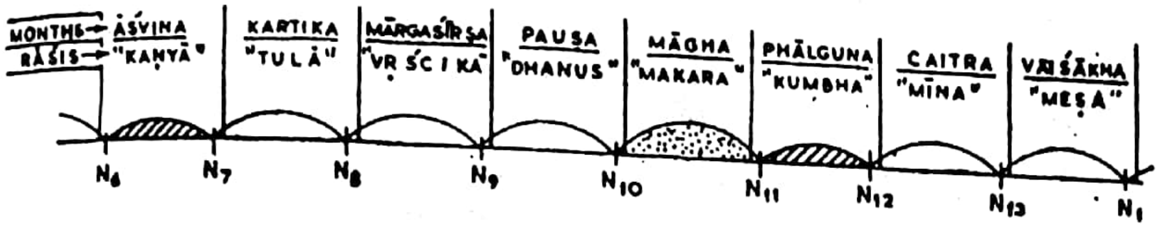


Diagram VI : Occurrence of two *adhika* months of Asvina and Phalguna and the *kshaya* month of Magha in the lunar year of 1904 Saka (1982-83 A.D.).

Note :

(a) N6, N7, N8 etc. are the positions of new-moons (ending moment of *amavasya*) in the sidereal solar months of Asvina, Kartika, etc.

(b) Lunar months N6-N7 and N11-N12 fall completely within the solar months of Asvina (Kanya *rasi*) and Phalguna (Kumbha *rasi*), and are, therefore, respectively *adhika* Asvina and *adhika* Phalguna. Again the lunar month N10-N11 completely overlaps or crosses over the solar month Magha (Makara *rasi*), and therefore causes a kshaya or missing lunar month of Magha.

Different conventions followed in treating the kshaya month

Unfortunately, like the different conventions adopted for determining the starting day of solar months, three different procedures are follwed to treat the kshaya month by three different schools, covering broadly three different regions. This regrettable non-uniformity amongst panchang makers of different regions causes celebration of the same festivals occuring in kshaya-month period on different days separated as much as one month, and this gives rise to confusion as well as detestation in the minds of the people. The three different procedures followed by three different Schools have been elaborated below :

(a) Eastern School

(generally followed in Eastern India and some eastern part of North India)

Under this procedure the first adhika month occurring before the kshaya month is treated as mala month or intercalary month, and no festivals or ceremonies are

Table VIII : Occurrence of Kshaya months with the two accompanying Adhika months, one before and one after the Kshaya month, in the period from 448 Saka (526-27 AD) to 1904 Saka (1982-83 AD)

Sl. No.	Saka	AD	Year interval	Kshaya month	Adhika months before and after Kshaya month
1	448	526–27	-	Pausha	Kartika – Phalguna
2	467	545–46	19	Pausha	Kartika – Phalguna
3	486	564–65	19	Pausha	Asvina – Phalguna
4	532	610–11	46	Margasirsha	Kartika – Vaisakha
5	551	629–30	19	Pausha	Asvina – Chaitra
6	692	770–71	141	Pausha	Asvina – Chaitra
7	814	892–93	122	Margasirsha	Kartika – Chaitra
8	833	911–12	19	Pausha	Asvina – Chaitra
9	974	1052–53	141	Pausha	Asvina – Chaitra
10	1115	1193–94	141	Pausha	Asvina – Chaitra
11	1180	1258–59	65	Pausha	Kartika – Chaitra
12	1199	1277–78	19	Pausha	Kartika – Phalguna
13	1218	1296–97	19	Pausha	Marga – Phalguna
14	1237	1315–16	19	Margasirsha	Kartika – Phalguna
15	1256	1334–35	19	Pausha	Asvina – Phalguna
16	1302	1380–81	46	Margasirsha	Kartika – Vaisakha
17	1321	1399–1400	19	Pausha	Kartika – Chaitra
18	1397	1475–76	76	Magha	Asvina – Phalguna
19	1443	1521–22	46	Margasirsha	Kartika – Vaisakha
20	1462	1540–41	19	Pausha	Asvina – Chaitra
21	1603	1681–82	141	Pausha	Asvina – Chaitra
22	1744	1822–23	141	Pausha	Asvina – Chaitra
23	1885	1963–64	141	Margasirsha	Kartika – Chaitra @
24	1904	1982–83	19	Magha	Asvina – Phalguna

@ According to old Surya Siddhantic method of calculation Pausha is Kshaya month, and Asvina and Chaitra are two Adhika months.

performed in this month. The adhika month occurring after the kshaya month is treated as a true or suddha month, that is, as a normal month, where all festivals, ceremonies, etc are performed in this month. This means, referring to Diagram VI on page 37, 1st adhika lunar month, N6 - N7, falling within the solar month Asvina, is treated as mala month, and the next lunar month N7 - N8, starting from the same solar Asvina, as suddha or normal lunar Asvina. Next lunar months N8 - N9 and N9 - N10 are named Kartika and Margasirsha nespectively as per normal rules. Again, the lunar month N10 - N11 which starts from solar Pausha and overlaps solar Magha, and ends in Phalguna, causing the kshaya lunar month of Magha, is termed as Pausha as per normal system of reckoning as it starts from the solar month of the same name. The adhika lunar month N11 - N12 falling within solar Phalguna is treated, as per this procedure, as suddha or normal month, and is termed as Magha, and this thus compensates for the kshaya or the missing month of the same name Magha. The subsequent lunar months N12 - N13 and N13 - N_1 are named, as per usual rule, Phalguna and Chaitra. Thus the 12 month structure of the lunar year is maintained.

(b) North Western School

(generally followed in North-West, and a part of West India and also western part of N. India)

Procedure followed here is opposite to that mentioned above for the Eastern School. Here the first adhika month is treated as true or normal month, and the second one after the kshaya month, as mala or intercalary month. Referring to the same diagram, lunar adhika month N6 - N7 is treated here as suddha or normal Asvina, and the following lunar months N7 - N8, N8 - N9 and N9 - N10, become then respectively Kartika, Margasirsha and Pausha, though, as per normal rule, these do not start from the solar months after which these are named. Similarly the lunar month N10 - N11, which starts from solar Pausha and overlaps solar Magha, is named as Magha. The adhika lunar month N11 - N12 is treated, under this procedure, as intercalary or mala Phalguna and the lunar month N12 - N13 is taken as per normal rule, true or normal Phalguna, and lunar month N13 - N1, as Chaitra. Here, also like the previous School, the 12 month structure of the lunar calendar is maintained, but the months of the same name occur one month earlier than the Eastern School with the result that the days for celebration of festivals under this School for the period between two adhika months are consequently fixed one month earlier.

(c) Southern School

(generally followed in South India and a part of western India)

In this School, the procedure followed is that both the adhika months are treated as mala months and no festivals are performed in these two months. To compensate for the kshaya or missing month, the peculiar procedure followed is that the lunar month that overlaps the solar month and which has thus two samkramanas, is treated as a 'jugma' or dual month. This is done by considering the first half of a tithi of this lunar month which has overlapped two rasi junctions, that is, has made two

samkramanas as already mentioned, as the tithi of the 1st month, and the second half of the same tithi as the tithi for the second month; and the time for festivals falling in these two months are arranged accordintly. Referring again to the Diagram VI, both the adhika lunar months N_6 - N_7 and N_{11} - N_{12} are treated here as mala months. The lunar month N_{10} - N_{11} whioch crosses over solar month of Magha, has two samkramanas (that is, crosses twice the junction points of solar months), namely those of Pausha-Magha and Magha-Phalguna and is treated as jugma or dual month as mentioned earlier. It will be observed that in this School the lunar months occurring before the jugma or dual month, N_{10} - N_{11}, get the names as per Eastern School, and those occurring after the jugma month get the names of the North-Western School, and as such, the days of festivals determined under this School accordingly coincide with those of the other two Schools in the said manner.

Table IX placed at page 41 shows how the kshaya or missing lunar month is compensated in different ways by treating the two adhika months differently by the three Schools and their effect on the name designations of lunar months that occur between two adhika months, taking the example of kshaya month that occurred in 1904 Saka, or 2039 Vikram, or 1982-83 AD.

It will be seen from the analysis given above what confusion exists in the Indian calendric system in the celebration of important religious festivals when a kshaya month occurs. There is thus urgent need to standardise the different procedures and conventions of our calendric system to bring about uniformity in the panchangs so as to avoid such confusion. In case of kshaya month, the procedure followed by the Eastern School may be adopted as the standard procedure where the first adhika month is treated as mala or intercalary month, and the second one as true suddha month. This will maintain well the sequence of occurrence of mala months and other months.

Purnimanta Calendar also known as Gaunamana Calendar

In this calendar the month covers the period from one full moon (ending moment of purnima) to the next, but is named after the amanta or new-moon ending month commencing a fortnight later. In other words, purnimanta lunar month begins a fortnight before the initial new moon of amanta lunar month, after which it is named, and ends in the middle of that amanta month. It will be interesting to note that while nearly the whole of amanta lunar month may sometimes fail outside the solar month with which it is linked, the purnimanta month would always cover at least half of the solar month in question.

The other features of this calendar are the same as those mentioned for amanta calendar. The months of this calendar are like the amanta calendar, divided into two halves - krishna paksha (vadi), and sukla paksha (sudi), but as stated earlier, purnimanta calendar month of the same name starts a fortnight earlier compared to the amanta calendar. Diagram VII at page 42 illustrates the relationship between amanta and purnimanta calendars. The timings for the occurrence of mala and kshaya months are

Table IX : How the kshaya or missing lunar month is compensated by treating the two adhika months that occur in a kshaya lunar year, in three different ways by the three Schools, and their effect on the name designations of the lunar months, taking the example of the lunar kshaya-month year of 1904 Saka, 2039 Vikram or 1982-83 AD, where the kshaya or missing lunar month was Magha.

Sl. No	Amanta lunar months as per notation in diagram	Gregorian calendar dates from new-moon to new-moon	Solar months in which amanta lunar months start	Name of amanta lunar months as per different Schools: East India & some eastern part of Noth India (I)	North west India & North India (II)	South & West India (III)
			1982			
1.	N6 to N7	17 Sep to 17 Oct	Asvina	Asvina (adhika)	Asvina (suddha)	Asvina (adhika)
2.	N7 to N8	17 Oct to 15 Nov	Asvina	Asvina (Suddha)	Kartika	Asvina (Suddha)
3.	N8 to N9	15 Nov to 15 Dec	Kartika	Kartika	Margasirsha	Kartika
			1983			
4.	N9 to N10	15 Dec to 14 Jan	Margasirsha	Margasirsha	Pausha	Margasirsha
5.	N10 to N11	14 Jan to 13 Feb	Pausha	Pausha	Magha Magha	Pausha &
6.	N11 to N12	13 Feb to 14 Mar	Phalguna	Magha (suddha)	Phalguna (adhika)	Phalguna (adhika)
7.	N12 to N13	14 Mar to 13 Apr	Phalguna	Phalguna (suddha)	Phalguna (suddha)	Phalguna
8.	N13 to N1	13 Apr to 13 May	Chaitra	Chaitra	Chaitra	Chaitra

Note : a) Under School I, the first adhika month, N6-N7, is treated as intercalary or mala, and the second one, N11-N12, as suddha or normal month.

b) Under School II, the first adhika month is treated as suddha or normal, and the second one as intercalary or mala month.

c) Under School III, both the adhika months are treated as mala, and the lunar month N_{10}-N_{11} which overlaps solar Magha, is treated as jugma or dual lunar month.

generally the same as those of the amanta calendar, that is, the first half of the first month, which is krishna paksha, is treated as suddha. The second half of the first month which sukla paksha, and the first half of the second month which is krishna paksha are treated as adhika or mala month. The second half of the second month which is sukla paksha is treated again as suddha. A limited few panchang compilers following purnimantra lunisolar calendar, however, treat the entire first purnimanta month as adhika or mala month and the second purnimanta month as nija or suddha month, deviating from the procedure followed by all amanta, and a large number of purnimanta panchanga makers.

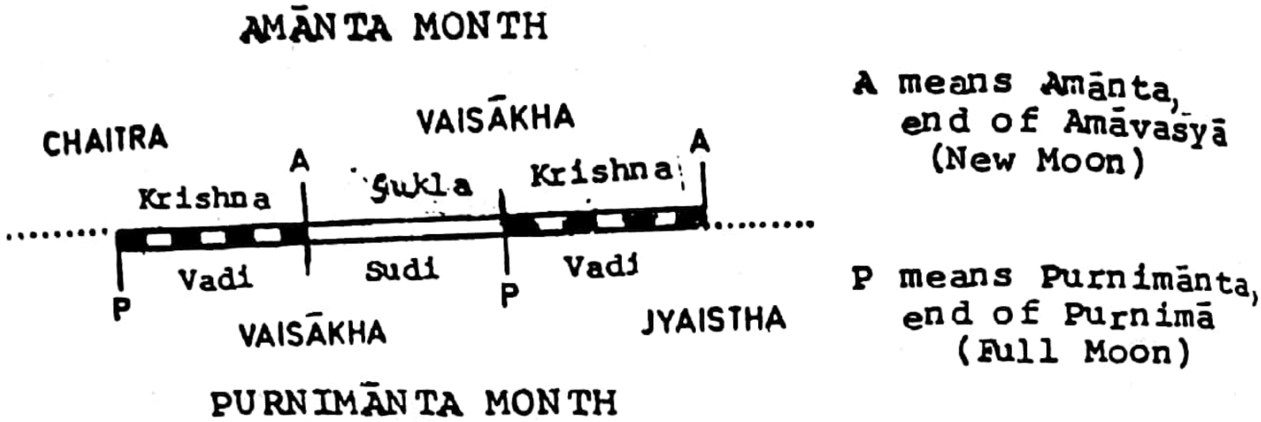


Diagram VII : Relationship between amanta and purnimanta calendars

The peculiar and somewhat perplexing feature of the purnimanta lunar calendar is that the first month of the year, that is, Chaitra and the year itself do not start at the same time. The year starts, like the amanta lunar calendar, with the ending of amavasya (new moon) in the solar month of Chaitra, but the month of Chaitra of this calendar starts about a fornight earlier with the ending of purnima, that is with full moon. This means that for the Purnimanta lunar calendar the year starts in the middle of the month of lunar Chaitra, resluting in the counting of the first half of Chaitra, that is vadi or krishna Chaitra, as part of the previous samvat year, and the latter half of Chaitra, that is sudi or shukla Chaitra, as a part of the next year, meaning that the new year commences with the beginning of the latter half of Chaitra, which is sudi Chaitra. Table X placed at pages 43 and 44 shows amanta and purnimanta months in years Saka 1915 and 1916, or Vikram 2050 and 2051, illustrating their relationship, and also the occurrence of mala month in Vikram 2050/Saka 1915, and how it keeps the lunar calendar adjusted, further, Table - XI at page 45 illustrates the process of omission and repetition of tithi-days of lunar months.

Purnimanta calendar is followed in Uttar Pradesh, Bihar, Madhya Pradesh, Rajasthan and north-west India including Kashmir.

Table X : Beginnings of Amanta and Purnimanta lunar months in relation to Gregorian calendar dates for the Vikram Samvat year 2050 and 2051 or Saka year 1915 and 1916 or Gregorian year 1993-94 AD and 1994-95 AD

Sl. No	Amanta lunar months	Corresponding Purnimanta lunar months	Beginnings of the lunar months in Gregorian calendar dates Vikram 2050 Saka 1915	Vikram 2051 Saka 1916
1.	Phalguna Krishna	Chaitra Krishna (Vadi)	9 Mar 93	28 Mar 94
2.	Chaitra Sukla	Chaitra Sukla (Sudi)	24 Mar @	12 Apr @
3.	Chaitra Krishna	Vaisakha Krishna	7 Apr	26 Apr
4.	Vaisakha Sukla	Vaisakha Sukla	23 Apr	11 May
5.	Vaisakha Krishna	Jyaistha Krishna	7 May	26 May
6.	Jyaishtha Sukla	Jyaishtha Sukla	22 May	10 June
7.	Jyaishtha Krishna	Ashadha Krishna	5 June	24 June
8.	Ashadha Sukla	Ashadha Sukla	21 June	9 July
9.	Ashadha Krishna	Sravana Krishna	4 July	23 July
10.	Sravana Sukla	Sravana Sukla	20 July	8 Aug
11.	Sravana Krishna	Bhadra Krishna	3 Aug	22 Aug
12.	Bhadra Sukla **(Mala)**	Bhadra Sukla **(Mala)**	18 Aug	
13.	Bhadra Krishna **(Mala)**	Bhadra Krishna **(Mala)**	2 Sept	
14.	Bhadra Sukla **(Suddha)**	Bhadra Sukla **(Suddha)**	17 Sept	6 Sept
15.	Bhadra Krishna **(Suddha**	Asvina Krishna **(Suddha)**	1 Oct	20 Sept

Beginnings of Amanta and Purnimanta lunar months in relation to Gregorian calendar (continued.)

Sl. No	Amanta lunar months	Corresponding Purnimanta lunar months	Beginnings of the lunar months in Gregorian calendar dates Vikram 2050 Saka 1915	Vikram 2051 Saka 1916
16.	Asvina Sukla	Asvina Sukla	16 Oct	6 Oct
17.	Asvina Krishna	Kartika Krishna	31 Oct	20 Oct
18.	Kartika Sukla	Kartika Sukla	14 Nov @@	4 Nov @@
19.	Kartika Krishna	Margasirsha (Agrahayana) Krishna	30 Nov	19 Nov
20.	Margasirsha Sukla	Margasirsha Sukla	14 Dec	3 Dec
21.	Margasirsha Krishna	Pausha Krishna	29 Dec	19 Dec
22.	Pausha Sukla	Pausha Sukla	12 Jan 94	2 Jan 95
23.	Pausha Krishna	Magha Krishna	28 Jan	17 Jan
24.	Magha Sukla	Magha Sukla	11 Feb	31 Jan
25.	Magha Krishna	Phalguna Krishna	26 Feb	16 Feb
26.	Phalguna Sukla	Phalguna Sukla	13 Mar	2 Mar
27.	Phalguna Krishna	Chaitra Krishna	28 Mar	17 Mar

Note :
1. Sukla and Krishna fortnights are also known as 'sudi' and 'vadi' in purnimanta calendar.
2. Year begins from Chaitra Shukla pratipada for both amanta and purnimanta calendars (marked by @). In Gujarat and parts of Rajasthan, where amanta calendar is followed, year starts from Kartika Sukla pratipada (marked by @@).
3. A mala or adhika or an intercalary lunar month of Bhadra occured in lunar year of 2050 Vikram/1915 Saka covering the period from 18 Aug to 16 Sept, 1993 AD. adjusting the lunar calendar to the solar.
4. Gregorian calendar dates for the beginnings of the lunar months are those as given in Rashtriya Panchang, and there are for the Central Station (Lat : 23° 11' of Ujjain, Long : 82°.5 of IST). As lunar day is based on the tithi at sunrise, there may be a difference by a day of some dates when calculated with reference to some other place.

Table XI : How the days of the months of a lunar year, counted on the tithi-number of the tithi-day at sunrise, are sometimes omitted and repeated

Illustration given is by the example of amanta lunar months of Chaitra and Vaisakha, corresponding to the purnimanta months of Chaitra Sukla, Vaisakha Sukla & Krishna, and Jyaistha krishna: Saka 1916, Vikram 2051

Sl No. of days	Chaitra Sukla tithi day	Gregorian dates	Sl No of days	Chaitra krishna tithi day	Gregorian dates	Sl No of days	Vaisakha Sukla tithi	Gregorian dates	Sl No of days	Vaisakha krishna tithi	Gregorian dates
		Apr 94			Apr 94			May 94			May 94
1	1	12	1	1	26	1	1	11	1	1 →	26
2	2	13	2	2	27	2	2	12	2	3	27
3	3	14	3	3	28	3	3	13	3	4	28
4	4	15	4	4	29	4	[4	14	4	5	29
5	5	16	5	5	30	5	4	15	5	6	30
					May						
6	6	17	6	6	1	6	5	16	6	7	31
											June
7	7	18	7	7	2	7	6	17	7	8	1
8	8	19	8	8	3	8	7 →	18	8	9	2
9	9	20	9	9	4	9	9	19	9	10	3
10	10	21	10	10	5	10	10	20	10	11	4
11	11	22	11	11	6	11	11	21	11	[12	5
12	12	23	12	12	7	12	12	22	12	12	6
13	13 →	24	13	13	8	13	13	23	13	13	7
14	15	25	14	14	9	14	14	24	14	14	8
15			15	30	10	15	15	25	15	30	9

Notes: a) This Table has been worked out on the basis of tithis at sunrise for the Central Station (Lat: 23° 11' for Ujjain: Long : 82° 30' for I.S.T.)

b) → shows 'missing' tithi-days

c) [shows "repeat" tithi-days

d) Sukla tihti-day no. 15 indicates Purnima tithi, and Krishna tithi-day no. 30 indicates Amavasaya tithi. ■

Weekday

Reckoning the continuous flow of days by means other than month-days, by the method of short cycle of 7 days, called as 'week', is common throughout the world. Luckily the names of the weekdays and also their sequence of occurence is the same, indicating that this mode of reckoning penetrated into different countries of the world from one source. The Indian name of the seven weekdays starting from Monday and their corresponding English names are shown below :

1.	Somavara	-	Monday
2.	Mangalavara	-	Tuesday
3.	Budhavara	-	Wednesday
4.	Vrihaspativara or Guruvara	-	Thursday
5.	Sukravara	-	Friday
6.	Sanivara	-	Saturday
7.	Ravivara	-	Sunday

It may, however, be noted that unlike year and lunar month, the seven-day week is an artificial man made cycle which was very likely evolved for easy reckoning of the days in cycles covering only a few days in which the day of rest and of worship repeats at regular short intervals without being linked to complicated astronomical system. This was found to be convenient by the common people, and became popular in all parts of the world.

In very early days, the ancient Egyptians followed a ten-day week system, while the early Vedic Indians had a six-day week system which was called as 'Shadaha'. These systems were not so extensively in use as the present 7-day week.

It is not firmly known which nation first introduced the 7-day weekly cycle, whether it was the Chaldeans or the Greeks. It is, however, generally believed that the Chaldeans, who practised astrology, and also were well versed in astronomy among the ancien nations, were the originator of this system. However, this weekly system of reckoning the days came into general use much later. It was introduced into use among the Christians by an edict of the Roman Emperor Constantine at about 323 AD. Evidence of first use of 7-day weekly system in India is found from the inscription of Emperor Budhagupta at 484 AD. The Chaldean week system had it's origin in planetory astrology in which the Sun, the Moon, and the five visible Planets that were thought to be really the gods who sitting together in solem conclave, controlled the

destinies of kings and men. It was believed that studying and interpreting their motions in the sky, the future of kings and men on earth can be forecast. Really this urge to know the future by studying and interpreting the movements of heavenly bodies became the root cause of development of astronomy.

Each planetary god had a name, and they were placed in a serial order staring from the one which is farthest in the heavens and ending with that which is closest, as shown below :

Serial number for the planetary gods	Planets	Chaldean god-names	Function of the gods
1	Saturn	Ninib	God of Pestilence & Misery
2	Jupiter	Marduk	King of Gods
3	Mars	Nergal	God of War
4	Sun	Shamash	God of Administration and Justice
5	Venus	Ishtan	Goddess of Love and Fertility
6	Mercury	Nabu	God of Writing
7	Moon	Sin	God of Agriculture

Again to discern how these planetary gods kept a watch, the period covering the day and night was divided into 24 equal parts, or watches, same as the modern hours, and each of the seven gods was believed to keep a watch on mankind over each of the 24 watches of the day and night in rotation, the day (which includes night) was named after the Planet god which ruled the first hour of that day. According to this belief, the ruling of the successive days by the planetary gods after which the days of the week were named, took the following pattern, the first day being shown as Saturday:

								Saturday					*Sunday*
Hours	1	2	3	4	5	6	7	8....14	15..21	22	23	24	25(1)
Gods watching	1	2	3	4	5	6	7	1......7	1.... 7	1	2	3	4
	(Saturn)												(Sun)

								Sunday		*Monday*
Hours	1	2	3	4	5	.....	11	12.....18	19.....24	25(1)
Gods Watching	4	5	6	7	1	.....	7	1..... 7	1 6	7
	(Sun)									(Moon)

It would be seen from the above illustrative chart that the serial number of the planetary gods that rule at the start of the day rotate in the order of 1, 4, 7, 3, 6, 2, and 5. This means that the planetary gods Saturn, Sun, Moon, Mars, Mercury, Jupiter, and Venus lord over the days in rotation, giving the present sequence of weekdays of Sani, Ravi, Soma, Mangala, Budha, Vrihaspati, and Sukra. The corresponding English names of these weekdays are Saturday, Sunday, Monday, Tuesday, Wednesday, Thursday, and Friday. Here the first three weekdays are named after the planets, Saturn, Sun, and Moon. The remaining four day namely, Tuesday, Wednesday, Thursday, and Friday are the adoption from the names of the Teutonic deities Tiu, Woden, Thor, and Frey respectively, which are the counter names of the Roman planetary deities of Mars, Mercury, Jupiter, and Venus. It is significant to note that functions attributed to the planetary gods by the Chaldeans are the same as given by our astrologers as well as those of other countries, and it seems, therefore, the planetary astrology as well as the method of naming the weekdays filtered into different countries of the world from the chaldeans. ■

Era

It has been mentioned that era is not directly linked with the structure of the calendar for reckoning systematically the days of the months and consequently the year. Nonetheless, era is a very important ingredient in the keeping of calendar because by this system it becomes possible to maintain a chronological record of all past, present, and future events which is very essential. Many of the eras have been regnal, and some linked with the founders of religions. Some of the regnal eras had fallen into disuse because of the death of the king or of vanishing of the empire or dynasty, like the eras of Gupta, Harsha, Tarikh Ilahi, etc.

India being an ancient and large country where many outstanding astronomers flourished and many kings ruled from time to time, many eras started here, and some of them have survived and continue to be used, a few of which on an all-India basis and a few on regional basis. Table XII has been prepared giving a list of the important eras that are now mainly in use, and this has been placed at page 50. This Table also shows the relationship of the epoch of these eras with the Gregorian calendar, and the regions where such eras are generally in use. The list does not include eras like Buddha Nirvana (epoch : −544 AD), Mahavira Nirvana (Epoch : −527 AD), Fasli I and II (Epoch : 1362 AD and 1364 AD), Parsi (Epoch : 630 AD), etc, because their use is confined relatively to some small section of people or small religious groups as compared to the eras shown in Table XII.

It may be remarked that Vikram era is generally used throughout north India where purnimanta luni-solar calendar is in vogue, except that it is also used with amanta luni-solar calendar popular in Gujarat. Saka era, on the other hand, is used throughout South India and Maharashra where amanta luni-solar calendar is in use. Saka era is also used along with the regional eras of regional solar calendars, and infact is more or less generally used all over India.

Unlike all other eras, the epoch of Kali era shown in the Table, is not linked with any king, or any religious founder or leader, and thus it is completely secular and unique in this respect. It's epoch, which goes back to an ancient time of −3101 AD or 3102 BC, was reckoned from some assumed time of happening of an astronomical event when it is said that all the luminaries were grouped together at the 1st point of the nirayana zodiac. This era was first mentioned by Aryabhata, and had been used by our astronomers of the past and is shown in all present-day panchangs. It is used throughout India both for solar and luni-solar calendars though may not be so extensively as the regional eras. Further, the ingenious and useful method of counting

Table XII: Different eras in use and their epochs with reference to the Gregorian Calendar

Sl. No.	Name of the Eras	Epochs of the eras with reference to the Gregorian Calendar	Regions where used
Solar Eras			
1.	Kali	AD year + 3101 from mid-April to December AD year + 3100 from January to mid-April	General era in use in all solar and lunar calendars
2.	Saka (National calendar)	AD year – 78 from 22 march to December AD year – 79 from January to 21 March	Only in National Calendar introduced by the Government of India in 1957
3.	Saka (Traditional)	AD year – 78 from mid-April to December AD year – 79 from January to mid-April	Tamil Nadu, Orissa and Punjab. As an additional era in Bengal, Assam & Tripura where Bengali San is used
4.	Bengali San	AD year – 593 from mid-April to December AD year – 594 from January to mid - April	West Bengal, Assam and Tripura
5.	Kollam	AD year – 824 from mid-August to December AD year – 825 from January to mid-August	Kerala
Luni-solar Eras			
6.	Salivahana Saka	AD year – 78 from March/April to December AD year – 79 from January to March/April	Maharashtra, Andhra Pradesh and Karnataka
7.	Vikram Samvat (Chaitradi)	AD year + 57 from March/April to December AD year + 56 from January to March/April	UP, Bihar, MP, Rajasthan and North-West India
8.	Vikram Samvat (Kartikadi)	AD year + 57 from October/November to December AD year + 56 from January to October/November	Gujarat and some parts of Rajasthan
9.	Vikram Samvat (Ashadadi)	AD year + 57 from June/July to December AD year + 56 from January to June/July	Kutch and some parts of Kathiawar

continuously the days of the ever flowing time from an assumed distant epoch without linking it to the days of the months and years of any calendar or to the vagaries of any calendric system, was first introduced in the world by Aryabhata I in C-499 AD by counting continuously the days from this Kali epoch, and this continuous count of days is called as Kali Ahargana, that is, Kali Day number. This important calendric matter has been elaborated later. ■

Nakshatra

Nakshatra is an important item in the Indian system of calendar keeping. The word literally means star, but in Indian calendric terminology, it means lunar mansion, that is, the division or segment of the zodiac in which the moon is found at any time of the day which includes night. Each of this division or segment is named against the name of a star which is generally prominent and generally placed in the lune of the celestial sphere covering the segment of the ecliptic covering the nakshatra division or close to it. These nakshatra divisions span equally on the ecliptic and their number has varied between 27 and 28 amongst ancient nations. The reason for this is that the mean sidereal period of the moon, that is, the time taken by the moon to return to the same fixed position in the zodiac in relation to the background stars, is about 27.32 days, but the actual period may very from this mean period by about seven hours.

The division of the zodiac into lunar asterism had been in use in China where it was called as 'Hsiu'. This system has also been prevalent amongst Arabs who termed it as 'Manzil', and both these designations mean 'mansion'. These countries divided the zodiac into 28 lunar mansions. In India also at some period zodiac was divided into 28 lunar mansions or nakshatra divisions, but ultimately 27 divisions were adopted.

The Indian system of calendar keeping is sidereal, and the initial point from which the nakshatra divisions are measured, is a fixed point on the ecliptic which is the same as that for rasi divisions. It means that both for rasi and nakshatra divisions, the initial point on the ecliptic is the vernal equinoctial point of 285 AD, which was then located opposite the star Chitra (α Virginis) (see page 7). As there are 27 nakshatra divisions and each division covers an angle of 13° 20' on the ecliptic, 2¼ nakshatra divisions cover one rasi division. So the ending point of ninth and eighteenth nakshatra divisions coincide respectively with the ending points of fourth and eighth rasi divisions.

Below is given in serial order the names of 27 nakshatras or nakshatra divisions, and the sidereal ecliptic longitudes at which these nakshatra divisions start. To corelate the starting angles of twenty seven nakshatras with twelve rasis, this angle has been shown in units of 30°, the angle covered by each rasi division or zodiacal sign. These units are marked by the sign 'S' in the manner as 1^s, 2^s, etc. meaning respectively angles of 30°, 60°, etc. For example, the starting longitudinal angle of Pushya nakshatra is 93° 20, and this is indicated as 3^s 3° 20'.

The nakshatras are often referred by their serial numbers as shown in the list. When this serial number is shown suffixed or prefixed, generally within brackets, with

Name of nakshatras and longitudes of their beginning points

Serial No. of nakshatras	Name of Nakshatras	Beginning longitude		
1.	Asvini	0S	0°	0'
2.	Bharani	0	13	20
3.	Krittika	0	26	40
4.	Rohini	1	10	0
5.	Mrigasira	1	23°	20'
6.	Ardra	2	6	40
7.	Punarvasu	2	20	0
8.	Pushya	3	3	20
9.	Aslesha	3	16	40
10.	Magha	4	0	0
11.	Purva Phalguni	4	13	20
12.	Uttara Phalguni	4	26	40
13.	Hasta	5	10	0
14.	Chitra	5	23	20
15.	Svati	6	6	40
16.	Visakha	6	20	0
17.	Anuradha	7	3	20
18.	Jyeshtha	7	16	40
19.	Mula	8	0	0
20.	Purvashadha	8	13	20
21.	Uttarashadha	8	26	40
22.	Sravana	9	10	0
23.	Dhanishtha	9	23	20
24.	Satabhisha	10	6	40
25.	Purva Bhadrapada	10	20	0
26.	Uttara Bhadrapada	11	3	20
27.	Revati	11	16	40

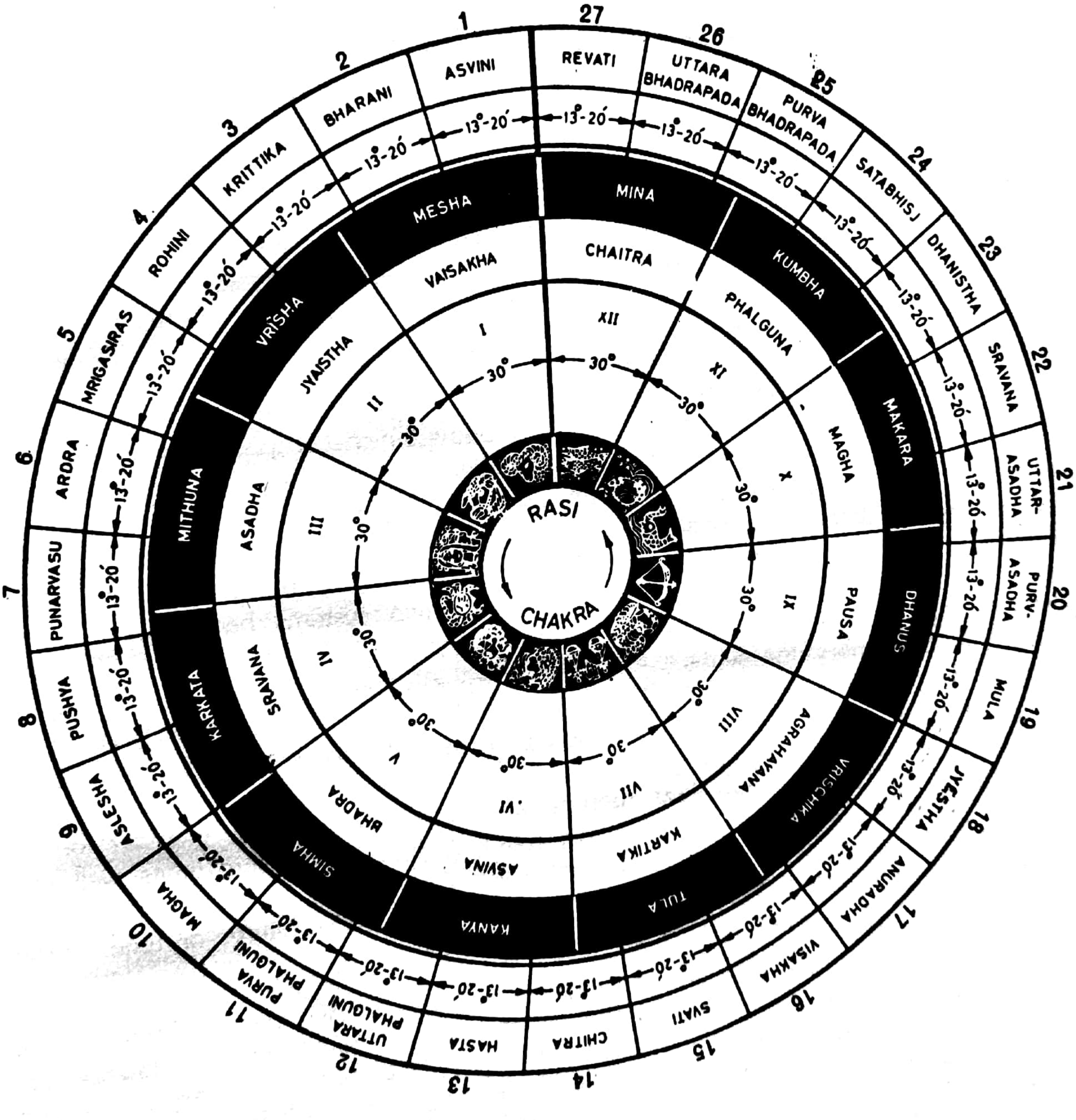
the longitudinal positions of the sun, the moon, and the planets, it indicates the nakshatra division in which the luminary is positioned. It may be remarked that the names of the nakshatras shown in the list above is what normally used in the Eastern part of the country which generally follows feminine version of the names. In other regions, some minor variation in some of the names may be found which are noted below :

Serial No. of nakshatra	Name shown in the list	Minor variation in the names in some regions
5.	Mrigasira	Mrigasiras
8.	Pushyaa	Pushya
13.	Hastaa	Hasta
19.	Mulaa	Mula
24.	Satabhisha	Satabhishaj
25.	Purvabhadrapada	Purvabhadrapadaa
26.	Uttarabhadrapada	Uttarabhadrapadaa

Diagram VIII has been placed at page 55 showing the relationship between the nakshatras and rasis. It also shows the sidereal months which are directly linked with the rasis. This may be said to be an augmentation of Diagram III illustrated earlier.

In ancient times, nakshatras were used to earmark the 'days'. Thus when the moon was in Magha nakshatra, or was expected to be there, the day was said to be 'Magha day'. This is the oldest method of designating the day because this method of reckoning is found in Rig Veda. Later, the method of designating the day by tithis, that is by lunar day, based on lunar phase of the moon came into use. In olden times, auspicious and inauspicious days were generally reckoned on nakshatra position the moon. As an example in Ashoka's records, a statement is found that Brahmanas and Sramanas (Buddhist monks) would be fed on Pushya nakshatra day as it was taken to be an auspicious day, and this act will enhance King's punya. Also in Mahabharata period it is found that the days were designated by nakshatras. Even to-day many of our religious functions and festivals are linked with nakshatras, that is, day and night period when the moon will be in a particular nakshatra division. For example, many sects observe midnight ceremony of Janmastami when the moon is at Rohini nakshatra on or near to Sravana krishna Ashtami day, Again in the South and other parts, Sarasvati sthapana is observed at Mula nakshatra occurring in Asvina Sukla Saptami or near to this tithi day. Similarly Sarasvati visarjana is observed on Sravana nakshatra day occurring at Asvina sukla dasami tithi or close to it.

Diagram VIII Relative dispositions of nakshatra divisions, rasis, and solar months.



Kali Ahargana

The main purpose of calendar keeping has been to mark the successive days in the continuous flow of time in a convenient and systematic manner so that any day of the past, present, or future events can be easily and precisely marked, communicated, and recorded. The counting of the successive days, as has been elaborated earlier, is done for natural reasons and for convenience in units of years divided into months and days.

The difficulty has been that there has not been any uniform calendric system of counting the length of years and so also the months which comprise the year. As far as solar calendar is concerned, as stated earlier, different regional calendars had developed in the past based on different constants and conventions, and it is often very difficult to determine which particular day of the year a regional calendar date refers, because the same calendar date may not always refer to the same day of the year in all regions. Again for lunisolar calendar, two systems had been followed, namely amanta and purnimanta, and in the latter type, as explained earlier, the lunar month of the same name starts a fortnight earlier. Also in the lunar type of calendar that is followed there is no continuity in counting the days of the months because the day-number is reckoned on the serial number of the tithi occurring at sunrise, and as such this number is sometimes repeated or omitted. Again to keep the lunar calendar adjusted to the solar, intercalary months are added at irregular intervals on an astronomical process. So all these factors make it difficult and sometimes well nigh impossible to express preceisely and unambiguously the time of an event that has happened in the distant past or forecoast an event of distant future, or time interval between two widely separated astronomical or other events.

To overcome this difficulty, Aryabhata I (born 476 AD) the celebrated Indian astronomer, introduced an ingenious method to earmark any day in the flow of time by the number of days that have elapsed from a specified epoch to the day in question, without making any reference to any type of calendar. The epoch for this purpose was taken to be that of Kali era which is at midnight of 17-18 February, – 3101 AD or 3102 BC. The number of days that have elapsed from this Kali epoch is known as Kali Ahargana or Kali day number. This system of reckoning has been of immense help in doing studies and research work in astronomical, epigraphical, historical, etc matters.

This ahargana or continuous system of counting the days was introduced much later in Europe in 1582 AD by Joseph Scaliger, a French scholar, and the epoch

chosen was 1 January −4712AD, and the days counted from this epoch were called 'Jullian Days' or Julian Day Number, after his father, Julius Scaliger. This system introduced by Joseph Scaligar may be said to be a copy of the system introduced by Aryabhatta about 1100 years earlier. The Julian day starts from mid-day of Universal Time while Kali day or Kali day number starts from midnight of Indian Standard Time. Julian day is now extensively used by present-day astronomers, and is shown against all Gregorian calendar dates for ease of reference for all astronomical work.

In the Indian calendric system as manifested in panchangs, Kali ahargana or Kali day number is not yet as extensively used as Julian Day Number by modern astronomers, but its application is tending to become popular because of increasing interest now being taken by calendric astronomers and panchang compilers in making use of modern formulae and techniques in the preparation of panchangs and other astronomical publications. It will be interesting to note the Kali Day number and the corresponding Julian Day Number for a certain date and observing the difference in days between them.

Gregorian calendar date	Kali Day No.	Julian Day No.
1995 Dec 31 - Jan 1 midnight (IST)	186,1253 (completed)	244,9718.271
1995 January 1, midday, U.T.	186,1253.729	244,9719 (completed)

Therefore, at any instant of time, Julian day number is more than Kali day number by 588,465.271 days. It may be remarked that originally Kali day was counted with reference to Ujjain time, but as that time has fallen into disuse long time back, it is now taken to be counted with reference to Indian Standard Time. ■

General Rules for Celebration of Religious Festivals

One of the important use of calendar has been to determine the dates for celebration of various religious festivals, socio-religious ceremonies, anniversary dates of birth and death of prominent persons and others, and also the dates for undertaking various rites and events like fasts, starting of an enterprise, buildings, etc. For this purpose, the use is normally made of two types of calendars in use, namely (a) solar calendar, and (b) luni-solar calendar. Determination of dates for celebration of some of the important festivals based on solar and luni-solar calendars have been eleborated in some detail with examples in subsequent paragraphs. In these examples have also been shown some festivals whose time for celebration is based on nakshatra position of the moon linked with certain tithi day of the lunisolar calendar. These have generally been illustrated along with the examples of festivals connected with the tihis as in most cases these are interlinked. It may be mentioned that fixing the time for celebrating most of the religious festivals is a little complicated because these are required to be performed within some particular time-period of the calculated date, and this period may be either in the day or the night. The time span within which the festival is to be celebrated is required to be calculated on the basis of the division of the day as per the traditional system, and for this purpose some special terms are used to indicate the time period for undertaking the festivals and ceremonies. These have been detailed below.

The length of the lunar year is shorter than the solar, and is kept adjusted to the latter by the addition of intercalary months, and hence the dates of festivals based on luni-solar calendar, oscillate in relation to the solar calendar. The example below shows the dates of Diwali festival as per Gregorian calendar for six years illustrating this oscillation of the date.

1. Saka 1914 - 25 Oct 1992
2. Saka 1915 - 13 Nov 1993
3. Saka 1916 - 2 Nov 1994
4. Saka 1917 - 23 Oct 1995
5. Saka 1918 - 10 Nov 1996
6. Saka 1919 - 30 Oct 1997

Division of the day as per traditional system

In the old Indian calendric system, for measuring time for general purposes as well as for determining as to when the festivals are to be celebrated, the day, which

is savana day, that is, from sunrise to sunrise, was divided as follows:-

1 day	=	60 ghatikas or danda	=	24 hours (appx)@
1 ghatika or danda	=	60 palas	=	24 minutes (appx)
1 pala	=	60 vipalas	=	24 seconds (appx)
1 vipala	=	……	=	0.4 second (appx)

@ The time 24 hrs, 24 mins, etc, are mentioned as approximate because time period from sunrise to sunrise at a place is not constant as the sunrise time varies from day to day and consequently also the length of savana day. Also sunrise time varies from place to place depending on the latitude of the place.

Along with the above system another one followed was to divide the day in terms of 'muhurta', which was 1/15th part of the day time (sunrise to next sunset). Similarly the night period (sunset to sunrise) was divided into 15 equal parts and each part was called ratri muhurta. One muhurta thus equals 2 ghatikas or 48 minutes. Another method, which is still popular, was to divide the period of day and night into eight equal parts, called prahara, and each prahara thus covers 3 hours. Even to-day the term astaprahara is used to denote the entire period of day and night. However, though the timings of various festivals are generally fixed on the basis of above divisions of the day, actual time of their performances are generally indicated as per modern method of reckoning the day in hours, minutes, and seconds. ■

Special Terms for Indicating Different Time-periods for Celebrating Festivals

Apart from ghatika and muhurta used for indicating the time for performing various festivals & ceremonies, some other special terms are used to determine the time period when such festivals should be performed, and these terms have been explained below:-

a) Yamardha	:	One-eighth of the day time, that is, about 1^h 30^m.
b) Arunodaya	:	Two muhurtas (about 1^h 36^m) before sunrise.
c) Pratah	:	First three muhurtas after sunrise, about 2^h 24^m after sunrise.
d) Purvahna	:	One third of the day-time from sunrise, that is, first five muhurtas covering about 4 hours from sunrise. Sometimes Purvahna is taken to cover the first half of the day.
e) Madhyahna	:	Second one-third of the day-time, that is, from 6th to 10th muhurtas, which cover the period from 5th to 8th hours from sunrise, or 10 AM to 2 PM, assuming sunrise is at 6 AM. Sometimes it is taken to cover only 7th, 8th and 9th muhurtas which will cover 2^h 24^m that is, from 10^h 48^m AM to 1h 12 PM. It may also be only two ghatikas (48m) covering midday, that is one ghatika before and one ghatika after miday, which is the mid-time from sunrise to sunset.
f) Aparahna	:	One third of the day before sunset. It is sometimes taken as the last half of the day, and also as 10th, 11th and 12th muhurtas of the daytime (from 1^h 12 PM to 3h 36^m AM assuming sunrise is at 6 AM).

g) Sayahna : One fifth of the day (about 2^h 24^m) before sunset (13th, 14th and 15th muhurtas).

h) Pradosha : Two muhurtas (about 1^h 36^m) after sunset. In some opinion this time may be taken to cover three muhurtas, that is, 2^h 24^m after sunset.

i) Nisitha or Madhya ratri : Two ghatikas covering midnight, that is, 24^m before and 24^m after midnight, which is to be taken to be the midtime from sunset to sunrise of the concerned day..

j) Purvaviddha : When the required tithi combines with the immediately preceding tithi.

k) Paraviddha : When the required tithi combines with the next following tithi.

The above two situations of (j) and (k), will arise for consideration in case when the desired moment for celebrating the festival on the basis of tithi is available on two successive days.

Generally the festivals are performed in the day time except those which are specially meant for celebration in the night time like Diwali, Kali puja, Sivaratri, etc. Normally the time prescribed for performance is purvahna (forenoon) or madhyahna (noon). However Samvatsarik Sraddha ceremony (annual homage to dead parents and grand parents), is geneally performed in the latter half period of the day. Diwali, and Mahalakshmi Puja connected with Diwali, are performed in pradosha, while Kali puja and Maha Sivaratri are performed in nisitha. When, however, the requisite tithi covers the prescribed time on two successive days, the festival is to be observed either on the 1st day (Purvabiddha) or on the second day (Paraviddha) according to laid down rules/convention for that particular festival which may sometimes have a regional variance. ■

Festivals and Anniversaries based on Solar Calendar

A few of the festivals and anniversaries that are celebrated on the basis of the solar calendar have been elaborated below, explaining how the time for their celebrations is fixed.

Festivals

a) New Year's day

This day is known as (a) 'Vaisakhi' in North and North-West India; (b) 'Navavarsha' in Bengal; (c) Bahag Bihu in Assam; (d) 'Vishu' in Kerala, etc. It is the 1st day of first month of Vaisakha, and comes about on the day when the sun enters the first rasi, Mesha, (sidereal Aries). But owing to following of different conventions in different regions for determining the starting day of the months (See page 13), this day in different regions may correspond to 13, 14, or 15 April of the Gregorian calendar.

b) Visvakarma Puja in Bengal

This is undertaken on the day the sun enters Kanya rasi (sidereal Virgo), which takes place round about 17 September.

c) Kartika Puja in Bengal

This is performed on the day the sun enters Vrischika (sidereal Scorpio) rasi, which takes place round about 16 November.

d) Makara Samkranti

This important all-India bathing festival takes place on the day when the sun enters Makara Rasi (sidereal Capricorn), and is known by the name Magh Bihu in Assam, Pongal in Tamil Nadu, Tai Pongal in Kerala, etc. This event comes about 14 January of the Gregorian calendar, each year.

e) Kumbha Mela

This Mela or religious congregation of people, both men and women, is easily the largest religious festival in the world where millions of people gather to have

darshan of the sadhus who come down to the Mela from Himalayas and from other parts of India, and to have baths, specially on certain auspicious days, in the holy water of the river by the side of which this Mela is held. This mela is held at four different places by turn and continues for about a month. The time and place for holding this unique Mela is decided, unlike other solar based festivals, not only on the position of the sun in a rasi division but also that of the planet Jupiter or Brihaspati, and this has been elaborated below:-

Sl. No.	Place of holding the Mela	Position of Jupiter and Sun in the rasi division	Appx. Gregorian date for start of the Mela
1.	Haridwar	Sun entering Mesha rasi when Jupiter is in Kumbha rasi – Purna Kumbha	Mid April
2.	Prayag (Allahabad)	Sun entering Makara rasi when Jupiter is in Vrisha rasi – Purna Kumbha	Mid January
3.	Prayag (Allahabad)	Sun entering Makara rasi when Jupiter is in Vrischika – Ardha kumbha	Mid January
4.	Ujjain	Sun entering Mesha rasi when Jupiter is in Simha rasi – Simhastha kumbha @	Mid April
5.	Nasik	Sun entering Karkata rasi when Jupiter is in Simha rasi	Mid July

Note @ At this time, also an Ardha Kumbha yoga is considered to happen at Haridwar, but this Kumbha is given less importance compared to the first three. This is apparently due to the fact of holding a Kumbha Mela at Ujjain at the same time, and that at Nasik only a few months later.

Auspicious bathing days, except the one on Vaisakhi day at Haridwar, are normally determined on the lunar days of purnima, amavasya, etc.

Anniversaries

1. Gurudev Rabindranath Tagore's birth-day is celebrated on 25 Vaisakha of the Indian solar calendar, the corresponding Gregorian calendar date being generally 9 May.

2. Indian Republic Day and Independence Day are celebrated on the basis of Gregorian solar calendar, this being now the official calendar. The dates for celebrating these national days are respectively on 26 January and 15 August.

3. Birth-day anniversaries of many celebrites are observed on the basis of Indian solar calendar, but for modern celebrites the present tendency has been to follow the Gregorian calendar date. However birth-days of religious leaders are normally celebrated on the basis of luni-solar calendar which has been described subsequently. ■

Festivals and Anniversaries based on Luni-solar Calendar

The date and time for celebrating most of the traditional Indian festivals as well as of the anniversaries of most religious founders and leaders are fixed on the basis of luni-solar calendar. Here luni-solar calendar means the tithi number or tithi day of both bright and dark halves of the concerned lunar months. As mentioned earlier the luni-solar year being shorter than solar year, it is kept adjusted to the solar by the addition of intercalary or mala months at some intervals, and hence the luni-solar calendar dates for celebration of festivals oscillate in relation to the solar calendar. Number of festivals celebrated on luni-solar calendar, which are sometimes also linked with nakshatras, are considerable, and may be more than four hundred or so. A limited few of these have been explained below for illustrating broadly the basis on which the date and time for celebration of these festivals are generally fixed.

a) **Vasanti Durga Puja (generally in Bengal, Orissa, Assam & Tripura)**

Celebrated from sukla saptami to sukla dasami of lunar month of Chaitra on parabiddha principle.

b) **Annapurna puja and Asokastami**

Annapurna puja observed on Chaitra sukla astami (parabiddha).

Asokastami is observed on the same lunar day, but assumes a special significance if the moon is then in Punarvasu nakshatra, and becomes more special if the day is a Wednesday.

c) **Ramanavami (birth anniversary of Lord Rama)**

Celebrated on sukla navami tithi of the lunar month of Chaitra in madhyahna. Dates for its celebration in relation to the Gregorian calendar for four Saka years from 1914 to 1917 is shown below:

1914 Saka (1992-93 AD) ...	11 April 92
1915 Saka (1993-94 AD) ...	1 April 93
1916 Saka (1994-95 AD) ...	20 April 94
1917 Saka (1995-96 AD) ...	9 April 95

@ Mala lunar Bhadra had occurred in 1915 Saka year, after the celebration of the festival in that year, in the period 18 Aug 93 to 16 Sept 93, and hence the festival

festival in the following 1916 Saka year occurred later by a long period of 19 days. This form of oscillation of dates is typical for all luni-solar festivals.

d) Akshaya Tritiya

Observed on Vaisakha sukla tritiya, (purvahna vyapini, parabiddha). It assumes a special significance when the moon is also in Rohini nakshatra.

e) Buddha Purnima (birth and Nirvana of Lord Buddha)

Celebrated on Vaisakhi purnima day.

This is also the start of the year of Buddha era year.

f) Rathayatra (Car festival of Lord Jagannatha of Puri)

Celebrated on sukla dvitiya of the lunar month of Asadha (paraviddha). Becomes of special significance when also moon is positioned in Pushya nakshatra.

g) Raksha bandhan, Rakhi Purnima, Jhulan Purnima, Balabhadra Puja (Orissa), or Naroli purnima (Cocoanut day)

These festivals are celebrated on lunar Sravana purnima day. Jhulan Yatra Samapan or Jhulan Purnima ceremony is, however, celebrated in pradosa.

h) Janmastami (Birth anniversary of Lord Krishna)

Celebrated on krishna ashtami of lunar Sravana in madhyaratri. If thithi covers two midnights, it is to be observed on the second day, stress is to be given when tithi combines with Rohini nakshatra.

For Vaisanavas, this festival is observed on the day next to the day when Saptami tithi has occurred.

In Assam and South India, it is observed either in Sravana Krishna ashtami or Bhadra krishna ashtami depending on the tithi occurring in solar Bhadra month.

i) Onam or Thiru Onam Day

Observed when the moon is in Sravana nakshatra in the month of solar Bhadra as madhyahna vyapini festival.

j) Ganesh Chaturthi or Vinayaka Chaturthi

Celebrated on Bhadra sukla chaturthi, purvabiddha,

–madhyahna vyapini

k) Navaratri

Begins with Asvina sukla pratipada, paraviddha principle.

l) Durga Puja; Saraswati Sthapana, Pujana, and Balidana

Durga Puja starts on Asvina sukla saptami tithi covering atleast one muhurta from sunrise, and extends to sukla navami tithi - all on paraviddha principle. Saraswati sthapana, Pujana, and Balidana are observed in the periods when the moon is respectively in nakshatras Mula, Purvashadha, and Uttarashadha, when the tithis are likely to be, but not necessarily, saptami, astami, and navami.

m) Vijaya Dasami and Dasahara (Dusserah), and Sarasvati Visarjana

Vijaya Dasami and Dusserah are observed on Asvina sukla dasami. In Bengal for Vijaya Dasami parabiddha principle is followed.

Sarasvati Visarjana ceremony is celebrated at or near the same tithi when the moon is in Sravana nakshatra.

n) Lakshmi purnima (Bengal, Assam, Tripura)

Celebrated on Asvina purnima at Pradosa. If purnima tithi covers two successive days, it is observed on the second day; otherwise on the first day.

o) Dipavali (Diwali), Mahalakshmi Puja, Kali Puja, and Mahavira Nirvana

Dipavali and Mahalakshmi Puja are celebrated on Asvina krishna amavasya in prodasa, while Kali Puja is celebrated in nisitha. For this reason celebration of these two festivals may differ by a day as it happened in 1916 Saka (1994 AD) when Kali Puja was performed on 2 November and Diwali on 3 November. Mahavira Nirvana day is also celebrated on the same amavasya day.

p) Bhatri Dvitiya or Bhai Duj

Celebrated on sukla dvitiya of lunar Kartika (Madhyahna-puravaviddha)

q) Vasanta panchami (Sarasvati Puja in Bengal)

Celebrated on Magha sukla panchami tithi on purvaviddha principle. Saraswati puja is celebrated in purvahna.

r) Mahasivaratri

Celebrated on Magha krishana chaturdasi in nisitha. If tithi occurs in two successive nisithas, it should be observed on the second day. However, there is an opinion on its observance on the first day.

s) Holikadahana, Dolayatra (Bengal), and Holi

Celebrated in Phalguna purnima; Holikadahana is done in the night of purnima, and Holi is observed on the day after holikadahana.

Dolayatra and also birth anniversary of Lord Chaitanya, are celebrated in Bengal and Orissa in the purnima tithi which has covered sunrise.

t) Madhukrishna Trayodasi

Observed on Phalguna krishna trayodasi. It is celebrated as Varuni festival if the moon is also in Satabhisaj nakshatra, and as Mahavaruni when in addition the day is a Saturday.

u) Chudamani Yoga

This yoga happens when in a locality solar eclipse takes place on a Sunday or a lunar eclipse on Monday night.

v) Guru Purnima

Observed on Ashadha purnima day on parabiddha principle.

A limited number of examples have been given in the text explaining broadly and briefly the rules which generally guide the fixation of date and time for celebration of various festivals and anniversaries. It should be remarked that only some of the general principles have been mentioned, and in some cases rules to be followed for determining date and time are quite complicated. However, for inquisitive readers a list of festivals has been added showing all the important lunar festivals that are performed on the basis of lunisolar calendar and mentioning briefly against each festival the general rule of its's observance, and this has been placed at pages 68 to 77. As only a few festivals are performed on the basis of solar calendar, this list covers nearly all the important festivals.

Lunar festivals in twelve lunar months and general rules for their observance

CHAITRA

S 1 Navaratrarambha (paraviddha).

S 3 Dolotsava, Gauri trtiya, Andolana tritiya, Saubhagya sayana vrata (paraviddha), Sarhul (Bihar).

S 5 Sri panchami or Lakshmi panchami (purvaviddha).

S 6 Asoka sashthi (Beng.) (paraviddha), Skanda sashthi (Orissa).

S 7 Vasanti puja (Bengal) (paraviddha), Oli beginning (Jain — eight days before full-moon).

S 8 Annapurna puja (Beng.) (paraviddha), Bhavani-utpatti (paraviddha), Asokashtami (Special when combined with naks. Punarvasu and Wednesday, after mid-day).

S 9 Ramanavami (madhyahnavyapini, special with Punarvasu naks.), Rama jayanti.

S 10 Dharmaraja dasami.

S 11 Kamada ekadasi, Dolotsava.

S 12 Damanotsava, Vamana dvadasi, Madana dvadasi.

S 13 Ananga trayodasi (purvaviddha), Mahavira Jayanti (Jain).

S 14 Madanabhanji, (Bengal & Orissa) (paraviddha), Sivadamanaka chaturdasi, Vishnu damanaka chaturdasi (paraviddha).

S 15 Chaitri purnima (paraviddha), Hanumat jayanti, Oli ending (Jain).

K 11 Varuthini ekadasi.

VAISAKHA

S 3 Akshaya trtiya (purvahna vyapini, paraviddha) (Special when combined with Rohini nakshatra and Wednesday), Chandanayatra, Parasurama jayanti (pradoshavyapini — if occurs on two successive days, the second day is to be observed).

S 5 Sankara jayanti.

S 6 Chandana sashthi (Bengal) (paraviddha).

S 7 Gangotpatti, (madhyahna vyapini, if occurs on two successive days, the first day is to be observed), Jahnu saptami, Sarkara saptami.

S 9 Sitanavami (Bengal & Orissa) (madhyahna vyapini).

S 11 Mohini ekadasi, Lakshminarayana ekadasi (Orissa).

S 12 Parasurama dvadasi (purvaviddha), Rukmini dvadasi (purvaviddha), Pipitaki dvadasi (Bengal) (paraviddha).

S 14 Nrisimha chaturdasi (pradosha vyapini — if it occurs on two successive days, the second day is to be observed, special when combined with nakshatra 'Svati', yoga 'Siddhi' and 'Saturday').

S 15 Sampat gauri vrata (paraviddha), Phuladola (Bengal & Orissa) (paraviddha), Gandhesvari puja (Bengal) purvaviddha), Buddha purnima, Vaisakhi purnima.

K 8 Trilochanastami (Bengal)

K 11 Apara ekadasi, Jalakrira ekadasi (Orissa).

K 14 Savitri chaturdasi (pradosha) (Bengal)

K 30 Vata-savitri vrata, Savitri amavasya (Orissa), Phalaharini Kalika puja (Bengal) (nisitha vyapini).

JYAISHTHA

S 1 Dasahara snanarambha (lasting for ten days)

S 3 Rambha trtiya (purvaviddha)

S 4 Uma chaturthi (Bengal & Orissa) (paraviddha).

S 5 Mahadeva vivaha (Orissa).

S 6 Aranya sashthi, Aranya gauri vrata, (paraviddha), Skanda sashthi, (purvaviddha), Sitala sashthi yatra (Orissa)

S 10 Ganga dasahara (special when combined with nakshatra 'Hasta', yoga 'Vyatipata', karana 'Gara' and Tuesday).

S 11 Nirjala ekadasi, Devavivaha, ekadasi (Orissa). Rukmini vivaha (Orissa).

S 12 Sri Rama dvadasi (purvaviddha), Champaka dvadasi (Orissa) (purvaviddha).

S 14 Champaka chaturdasi (Bengal) (paraviddha).

S 15 Vata-savitri vrata (Deccan) (pradoshavyapini, purvaviddha), snanayatra (Bengal & Orissa) (paraviddha).

K 11 Yogini ekadasi

ASHADHA

S 2 Rathayatra (paraviddha, special when combined with nakshatra 'Pushya'), Manoratha dvitiya (it is to be observed only when the tithi touches both day and night on the date of observance and when the moon becomes visible).

S 5 Skanda panchami (paraviddha).

S 6 Kumara sashthi, Herapanchami (Orissa), Kardama sashthi (Bengal) (paraviddha).

S 7 Vivasvat saptami (purvaviddha).

S 8 Parasuramashtami (Orissa), Kharchi puja (Tripura).

S 10 Punaryatra (on the ninth day from Rathayatra).

S 11 Harisayani ekadasi, Ravinarayan ekadasi (Orissa).

S 12 Vishnu sayanotsava, Srikrishna dvadasi, Gopadma-vratarambha.

S 14 Chaumasi chaudas (Chaturmasya chaturdasi) (Jain), Sivasayana chaturdasi (Orissa).

S 15 Guru purnima (paraviddha), Vyasa puja (paraviddha, 3 muhurtas after sunrise), Kokila vrata (sayahna vyapini).

Siva sayanotsava (pradoshavyapini).

K 2 Asunya sayana vrata (chandrodaya vyapini; purvahna vyapini and purvaviddha in Bengal).

K 5 Naga panchami (Bengal) (purvaviddha).

K 7 Sitala saptami (Orissa).

K 11 Kamika ekadasi

K 30 Chitau amavasya (Orissa), Karkataka vavu (T.C. State — in Saura Sravana).

S 3 Madhusrava (Gujarat) (paraviddha).

S 5 Naga panchami (paraviddha),

S 11 Putrada ekadasi, Jhulanayatra (pradosavyapini or Purvahnavyapini).

S 12 Buddha dvadasi, Damodara dvadasi (purvaviddha), Vishnu-pavitraropana.

S 13 Akhetaka trayodasi (Orissa).

S 14 Siva pavitraropana (Orissa) (ratrivyapini)

S 15 Rakhi purnima, Naroli purnima (Cocoanut day), Raksha bandhana (in the second half of purnima), Rishi tarpana (madhyahna vyapini), Hayagriva utpatti, Jhulanayatra samapan, Balabhadra puja (Orissa).

Avani Avittam (South India) — But in some places, on the day of Dhanishtha nakshatra falling on S 14 or 15; if Dhanishtha is not available before K 1, it is to be observed on the day of Dhanishtha nakshatra of the next month.

Upakarma (Samgavavyapini i.e. S 15 covering 4th, 5th and 6th muhurtas) — (1) For Rigvedis, it is to be observed on the day of Sravana nakshatra falling on S 14, S 15 or K1.

(2) For Yajurvedis — if samkramana or eclipse occurs on the day, or Jupiter or Venus be heliacally set, then it is to be observed in Bhadrapada purnima and if that is also objectionable, it is to be observed in Ashadha purnima.

K 2 Asunyasayana vrata (Dvitiya current at moonrise; if occurs on two successive days, it is to be observed on the second day.

K 3 Kajjali trtiya, (paraviddha), Angaveta tritiya (Orissa).

K 4 Bahula chaturthi (Madhyadesa) Sayahnavyapini: if occurs on two successive days, it is to be observed on the 1st day.

K 5 Raksha panchami (Orissa) (purvaviddha).

K 6 Hala sashthi (paraviddha).

K 7 Sitala saptami (purvaviddha).

K 8 Janmashtami (madhyaratra-vyapini), if midnight is covered on two days, or not on any day, it is to be observed on the 2nd day; special when combined with nakshatra 'Rohini' at midnight, more so when on Monday or Wednesday. If the combination occurs before midnight, it is to be observed on that day. Gokulashtami.

For Vaishnavas : It is to be observed next to the day of saptami.

In Assam and S. India : It is to be observed in Sravana K 8 or Bhadra K 8 falling in the month of saura Bhadrapada. In S. India some observe in Rohini nakshatra.

K 11 Aja ekadasi.

K 12	Paryushana parvarambha (Jain-panchami paksha) — Eight days before Samvatsari.
K 14	Aghora chaturdasi (Pradosa vyapini).
K 30	Pithori amavasya, Aloka amavasya, Saptapuri amavasya (Orissa), Kusagrahana.

BHADRA

S 1	Rudra vrata (purvaviddha)
S 3	Haritalika vrata (paraviddha), Gauri vrata (Orissa), Gauri (Mysore)
S 4	Varada chaturthi (purvaviddha, madhyahnavyapini), Samvatsari parva (Jain-chaturthi paksha), Saubhagya chaturthi (Bengal), Ganesa chaturthi (madhyahna vyapini and purvaviddha), Haritali chaturthi (S 4 of saura Bhadra), Sarasvati puja (Orissa).
S 5	Rsi panchami (madhyahnavyapini) — If occurs on two successive days, it is to be observed according to Madhava on the 1st day, and according to Hemadri and Divodasa on the 2nd day; Raksha panchami (Bengal), Guru panchami (Orissa), Samvatsari parva (Jain panchami paksha).
S 6	Surya sashthi (paraviddha), Lolarka sashthi, Charpata sashthi & Manthana sashthi (Bengal), Champa sashthi (when combined with nakshatra Visakha and yoga Vaidhrti and Tuesday), Somanatha vrata (Orissa).
S 7	Muktabharana vrata (purvaviddha), Lalita saptami (Bengal & Orissa).
S 8	Durvashtami (purvaviddha — S 8 of saura Bhadra except Bengal), Mahalakshmi vratarambha, Radhashtami (madhyahna vyapini), Durga sayanashtami (Orissa).
S 9	Aduhkha navami, Nanda navami, Tala navami (Bengal & Orissa) purvaviddha).
S 11	Parivartani ekadasi, Vishnu srinkhalayoga — when combined with naks. Sravana and 12th tithi, Heikra Hitomba (Manipur), Dol gyaras (M.P.)
S 12	Visnuparivartanotsava, Sakrotthana (in any of the naksatras U. Asadha, Sravana & Dhanishtha), Kalki dvadasi, Sravana dvadasi (when combined with nakshatra Sravana), Vamana jayanti (madhyahna vyapini).
S 14	Ananta chaturdasi (covering three muhurtas from sunrise, but one muhurta in Bengal).
S 15	Indra-Govinda puja (Orissa) (pradosha).
K 1	Mahalayarambha.
K 2	Asunya sayana vrata (vide K2 of Sravana).
K 6	Chandra sashthi (Sashthi current at moon-rise; if occurs on two successive days, it is to be observed on the first day).
	Kapila sashthi — when combined with nakshatra Rohini, yoga Vyatopata, Sun in Hasta and Tuesday.

K 8 Mahalakshmi vrata samapana (current at moonrise), Jitastami (pradosha), Jimutavahana puja, Mulastami (Orissa).

K 9 Matri navami, Avidhava navami, Durga navami (Maharashtra).

K 11 Indira ekadasi

K 13 Magha trayodasi (in Magha nakshatra even in malamasa). *Gajacchaya* when Sun in Hasta naks).

K 30 Mahalaya amavasya (aparahnavyapini)

ASVINA

S 1 navaratrarambha (paraviddha).

S 4 Mana caturthi (Bengal & Orissa).

S 5 Upanga-lalita vrata (Maharashtra) (purvaviddha, in some opinion ratri vyapini), Nata panchami (Orissa)

S 6 Durga sashthi, Tapahsashthi (Orissa).

S 7 Durga saptami (paraviddha) — covering one muhurta from sunrise, Sarasvati sthapana (to be observed in Mula nakshatra, not necessarily in S 7).

Oli beginning (Jain) — Eight days before full-moon.

S 8 Mahashtami (paraviddha), Sarasvati pujana (to be observed in nakshatra P. Ashadha)

S 9 Mahanavami (purvaviddha) (In Bengal it is observed as paraviddha covering one muhurta from sunrise).

Sarasvati Balidana (to be observed in nakshatra U. Asadha)

S 10 Vijaya dasami (In Bengal it is observed as paraviddha, covering one muhurta from sunrise. In other places, if it touches Sravana nakshatra in the day time it is observed on that day), Sarasvati visarjana (to be observed in nakshatra Sravana); Dasahara.

S 11 Pasankusa (Papankusa) ekadasi, Bharat Milap.

S 12 Padmanava dvadasi.

S 15 Kojagari Laksmi purnima (pradosa vyapini) — (If occurs on two successive days, it is to be observed on the second day, otherwise on the first day), Kumara purnima (Orissa), Oli ending (Jain).

K 2 Asunya sayana vrata (vide K 2 of Sravana).

K 4 Karaka chaturthi (current at moon-rise, if occurs on two successive days, it is to be observed on the first day), Dasaratha chaturthi (Bengal) (pradosha vyapini) — If occurs on two days, then to be observed on the first day.

K 8 Ahoyi ashtami (Gujarat) (current at moonrise), Karastami (Maharashtra). If occurs on two successive days, it is to be observed on the second day.

K 11	Rama ekadasi.
K 12	Govatsa dvadasi (pradosavyapini). If occurs on two days, it is to be observed on the first day.
K 13	Yama dipadana (pradosha).
K 14	Naraka chaturdasi (covering a period of 4 ghatikas before sunrise, if occurs on two successive days, it is to be observed on the first day), Bhuta chaturdasi, Dipadana, Sastrahata chaturdasi, Hanumat Janmadina.
K 30	Kali puja (nisithavyapini), Dipavali or Diwali (pradosha), Mahalakshmipuja (pradosha), Kethar Gauri vrata (S. India), Mahavira nirvana (Jain).

KARTIKA

S 1	Govardhana puja, Annakuta [purvaviddha], Balidaityaraja puja (pradosha), Dyuta pratipad (purvahna).
S 2	Bhratridvitiya, Yamadvitiya (madhyahna, purvaviddha), Masyadhara (Dwat) puja (Bihar)
S 3	Alochana Gauri vrata (paraviddha).
S 4	Naga chaturthi (paraviddha and madhyahnavyapini).
S 5	Jnana panchami (Jain).
S 6	Nadi sashthi, Skanda sashthi (Madras), Surya sashthi, Chhat (Bihar).
S 8	Gopashtami, Gosthashtami.
S 9	Akshaya navami (purvahnavyapini), Jagaddhatri puja (Bengal). (udayavyapini one muhurta), Anla navami (Orissa), Durga navami (purvaviddha), Gauri vrata.
S 11	Tulasi vivaha, Bhisma panchaka, Probodhani ekadasi.
S 12	Probodhanotsava, Narayana dvadasi, Vrindavana dvadasi, Garuda dvadasi (Orissa).
S 14	Vaikuntha chaturdasi (ratrivyapini), Chaumasai chaudas (Jain), Bada osha (Orissa).
S 15	Rasayatra, (nisithavyapini, i.e. covering a period from 24 minutes before to 24 minutes after midnight. If occurs on two days or does not occur on any day, it is to be observed on the second day), Puskar Fair. Ratha yatra (Jain), Tripurotsava (evening), Kedara vratta (Orissa), Kartiki purnima.
K 8	Kalastami (ratrivyapini, paraviddha), Kalabhairava jayanti, Prathamastami (Orissa).
K 9	Kanji Anla navami (Orissa).
K 11	Utpanna (Utpatti) ekadasi.
K 30	Dipavali amavasya (Orissa).

MARGASIRSHA or AGRAHAYANA

S 1 Rudropavasa.

S 5 Naga panchami (2nd) (paraviddha).

S 6 Champa sashthi (Maharashtra) paraviddha). (Special when combined with nakshatra Satabhisaj, yoga vyatipata and Sunday), Skanda sashthi (purvaviddha), guha sashthi, Mulakarupini sashthi.

S 7 Mitra saptami (purvaviddha).

S 11 Mokshada (moksha) ekadasi, Mauna ekadasi (Jain).

S 12 Matsya dvadasi, Akhanda dvadasi (paraviddha), Vyanjana dvadasi & Dana dvadasi (Orissa).

S 14 Pasana chaturdasi (Bengal & Orissa) (In saura Margasirsa, night).

S 15 Dattatreyotpatti (pradosha).

K 8 Pupastaka.

K 11 Saphala ekadasi.

K 30 Vakula amavasya (Orissa).

PAUSHA

S 6 Annarupa sashthi (Bengal).

S 10 Samba dasami, surya puja (Orissa).

S 11 Putrada ekadasi, Vaikuntha ekadasi (Madras), (In Saura Pausha).

S 12 Kurma dvadasi.

S 15 Pushyabhishekayatra (Special when combined with Pushya naksatra).

K 8 Mamaashtaka

K 11 Sattila ekadasi.

K 13 Meru trayodasi (Jain).

K 14 Yama tarpana (covering a period of 4 ghatikas before sunrise), Ratanti Kalika puja (Bengal), (pradoshavyapini or nisithavyapini).

K 30 Mauna amavasya (Uttar Pradesh), Triveni amavasya (Orissa), Makara vavu (Kerala).

Ardhodaya Yoga — when combined with naksatra Sravana, yoga Vyatipata and Sunday at day-time.

MAGHA

S 4 Tila chaturthi and Kunda chathurthi (pradoshavyapini), Varada chaturthi (Bengal & Orissa), Ganesa chaturthi, Ganesa Jayanti (madhyahnavyapini purvaviddha).

S 5	Sri Panchami (purvaviddha), Sarasvati puja (Bengal), Vasanta pancami, Madana panchami.
S 6	Sitala sashthi (Bengal).
S 7	Ratha saptami (covering 4 ghatikas before sunrise), Acala saptami, Vidhana saptami, Arogya saptami [purvaviddha].
S 8	Bhismashtami
S 9	Mahananda navami
S 11	Jaya ekadasi, Bhaimi ekadasi (Bengal).
S 12	Bhishma dvadasi (purvaviddha), Amlaki dvadasi, Santana dvadasi, Varaha dvadasi.
S 15	Maghi purnima (paraviddha), *Mahamaghi* — when Jupiter and Moon in naksatra Magha, Sun in Sravana and Saturn in Mesa, Agnyutsava (night) (Orissa).
K 8	Sakashtaka Sitashtami (Birth day of Sita).
K 11	Vijaya ekadasi.
K 14	Mahasivaratri (nisithavyapini) - In some opinion it is to be observed on nisitha, and in some opinion on pradosha. If occurs on two successive nisithas, then according to Hemadri, it is to be observed on the first day but according to Madhava to be observed on second day.

PHALGUNA

S 4	Santa chaturthi (paraviddha) (Orissa).
S 6	Gorupini sashthi (Bengal)
S 10	Phagu dasami (Orissa).
S 11	Amalaki ekadasi.
S 12	Nrisimha dvadasi (It is called Govinda dvadasi when combined with Pushya nakshatra).
S 14	Chaumasi chaudas (Jain).
S 15	Holika-dahana (Sayahnavyapini — it should be observed on second half of purnima at night), Dolayatra (Bengal & Orissa) (covering 4 ghatikas before sunrise of the day of festival), Holi — on the day after Holikadahana.
K 1	Vasantotsava (current at sunrise, if occurs on two successive days, it is to be observed on the first day).
K 5	Ranga panchami.
K 6	Skanda sashthi (Bengal) (purvaviddha).
K 8	Sitalashtami, (purvaviddha), Varshitaparambha (Jain).

K 11 Papamochani ekadasi.

K 13 Madhukrishna trayodasi

(Varuni, when combined with nakshtra Satabhishaj; Mahavaruni, when combined with nakshatra Satabhishaj and Saturday; Mahamaha Varuni when further combined with yoga Subha).

Observance of Ekadasi —

As regards *Ekadasi*, there are various rules for determining the date for fasting. The general rule prevalent in most part of India is that it is to be observed on the day when the *tithi* is current at sunrise. If it occurs on two successive days, it is to be observed on the second day. When it does not occur on any day, it is to be observed on the day of the *tithi*, but widows and sannyasins would observe on the next-day. But in Bengal in such cases, it is to be observed on the succeeding day by all i.e., the day of combination of dasami with ekadasi is avoided. The Vaisnavas avoid such combination even at arunodaya (4 ghatikas before sunrise), Nimbarka Vaisnavas avoid such combination even after the preceding midnight.

Note : 1) S 1, S 2, etc., denote sukla pratipada, sukla dvitya, etc., and K1, K2, etc., denote krishna pratipatia, krishna dvitiya, etc. S 15 denotes Purnima, and K 30 denotes Amavasya.

2) This list of festivals is the same as that given in the Report of the Calendar Reform Committee - 1955, published by Council of Scientific & Industrial Research. ■

Difference in the Ending Moments of Tithis between the Old and Modern School Panchangs

The timings for celebration of luni-solar festivals are linked with the timings of tithis which are required to be calculated on the true positions of the moon and the sun. The moon's motion is very complex and erratic, and to find its true position at any instant of time modern astronomers apply a very large number of corrections to its mean motion, of which four most important ones are as follows: a) Equation of the centre : inequality of motion due to the elipttical path around the earth which occupies one of the focili; b) Evection : inequality of motion due to variation of eccentricity of the elliptical orbit of the moon causing a variation in the equation of the centre; c) Variation : inequality in the motion due to variation of magnitude of attraction of the sun on the moon of the earth-moon system, on account of its being nearest to the sun during conjunction, and farthest from it during opposition; d) Annual Equation : inequality of motion due to annual variation of distance of the earth-moon system from the sun of account of its annual orbital motion through perihelion and aphelion points.

All the calendric information on celebration of various festivals, performance of different ceremonies, rites, and also on astronomical and astrological matters are given in an annual publication called "panchang" or "panjika", which is published from all regions and in all languages, and is possessed almost in every household, and this book exerts great influence on the religious and social life of the people. However, there happens to be mainly two schools of panchang makers, namely a) Modern School and b) Conservative or Old School. For computing the basic items of the panchang, the Modern School use the true positions of the sun and the moon which they obtain generally from modern Astronomical Ephemeris. A section of this School use tables and guide books like Jyotirganita by Ketkar (1890), are prepared on the basis of the Astronomical Ephemeris, for compiling their panchangs. This School use the correct length of the sidereal year and also true position of the luminaries as observed in the sky. The Conservative or Old School, on the other hand, follow the formulae and rules given in the old and well known astronomical treatise named as 'Surya Siddhanta' for computing their panchangs. Strictly this school may be called as Surya Siddhanta School. In actual practice, however, the Old Surya Siddhanta School follow the Tables or Saranis compiled by later astronomers on the basis of

siddhantic formulae and length of the year, sometimes after making some additions and alterations, like Makaranda Sarani (1478 AD), Ganesh Daivajnya's Graha Laghava (1520 AD), Raghavananda Sarani (1591 AD), Ramchandra Sarani (1644 AD), etc.

It is not definitely known who composed the original Surya Siddhanta, and when it was first compiled. It is generally believed that the original book in some form was introduced sometime near about 300 AD but the original book is not traceable and the later version of this book is now in use. However, it is the first astronomical treatise where rules were laid down to determine true motion of the luminaries which would conform to their actual positions in the sky, and for framing a calendar on the basis of the true motion of the sun and the moon. Earlier, only astronomical book available for calendric purposes was Vedanga Jyotisha where the calendric system was on the approximate mean motion of the sun and the moon which was in a sense crude in comparison to advanced Surya Siddhantic system. However, in this early period it took considerable time for Surya Siddhantic system to replace the old Vedanga Jyotisha system which had dominated for the last 1500 years and so, and it is only around 400 AD that the new system came into general use.

To find the true position of the moon Surya Siddhantic astronomers provided correction for the inequality of its motion for the first cause mentioned in the first paragraph, which is Equation of the Centre. Correction required to be applied for this cause was well known to the siddhantic astronomers which is evident from the fact that they effected similar correction to the mean motion of the sun to find its true motion, though the expression used by them gave a little higher value than the correct one.

Surya Siddhantic astronomers, however, did not cater for corrections for the other remaining inequalities to find the true position of the moon at any instant of time. This has been resulting in the ending moments of tithis, nakshatras, etc., shown in panchangs following the Old Surya Siddhantic School not tallying with those shown in the panchangs of Modern School which are compiled on the true position of the sun and the moon in the sky. The difference in the ending moments of tithis, which determine the time for celebration of festivals, performance of ceremonies, etc. shown in the panchangs of these two schools may sometimes be as much as 6 hours. The reason for Surya Siddhanta not providing for corrections for other inequalities of motion was perhaps for the fact that when original surya Siddhanta was written, which was near about 300 AD, the knowledge of positional astronomy then was not so advanced as now, not only in India but in any country of the world, to cater for all the corrections needed to find the true position of the moon at any instant of time which would conform to its actual position in the sky.

However, it should be mentioned that the corrections needed for other inequalities were suggested by later astronomers, namely Munjala (932 AD), Sripati (1028 AD), and Bhaskara II (1150 AD), but unfortunately their proposals were not accepted by other astronomers of that time. The reason perhaps was that the introduction of Surya Siddhantic system of positional and calendric astronomy was an astounding forward leap over the Vedanga Jyotisha system of calendar keeping, which was in comparison a rough system based on approximate periods of motion of the

sun and the moon though it remained in use in the country for a very long period from C 1400 BC till about 400 AD when it was replaced by the new system. For calendric items, Surya Siddhanta introduced for the first time the use of true motion of the luminaries whose positions could be verified by making visual observations in the sky which was not so before. Owing to this spectacular advancement of astronomical knowledge, popular belief was created that the treatise, Surya Siddhanta, was a revealed one, and as such the proposals made from time to time by learned astronomers for making some improvements on the formulae given in the book so that theoretical calculations tallied with practical observations were not entertained. This unscientific attitude that Surya siddhanta can not be wrong, has been harmful to the progress of Indian astronomy, and it is still preventing a section of panchang makers in updating their panchangs by using correct ephemerides of the luminaries.

Difficulty is often faced with the time for celebration of festivals when two different panchangs, namely the one prepared as per Old Surya Siddhanta School, and the other as per Modern School, are followed in the same locality or region, and these show appreciable difference in the ending moments of the tithis with which are linked the determination of time for celebration of festivals. In that case two different time may be followed by two different groups of people for celebration of the same festival, and in some extreme case, this difference may even lead to the situation in the celebration of the same festival on two succeeding days. This disturbing situation has been analysed in some detail in the following paragraphs.

To explain explicity the situation mentioned in the preceding paragraph, Table XIII has been prepared and has been placed at pages 82 and 83, which shows the ending moments of tithis for lunar month of Magha as given in the panchangs of the Old Surya Siddhanta School, and Modern School, for the year 2052 Vikram, or 1917 Saka or 1996 AD, and the difference between these tithi timings. It will be observed from Col 5 of the Table that the error involved in the ending moments of tithis obtained by the process followed by the Old School as compared to the Modern School, had been on some day in excess by as much as 5^h 32^m, and on some day had been less by as much as 4^h 24^m. This difference in the ending moments of the tithis, often lead to the celebration of festivals and observance of ceremonies in different times by the two Schools. In some cases this difference may be such that the day for observing the same festival may be indicated in two succeeding days as it happened for Vasant Panchami or Saraswati Puja festival that fell in lunar Magha of 1917 Saka or 1996 AD which Table XIII discloses, and has been explained in the next paragraph.

It will be observed from the aforementioned Table that according to the Old School chaturthi tithi ends at 11^h 19^m on 24 Jan 96 when panchami starts, and this tithi ends at 10^h 08^m on 25 Jan 96. Hence 25 Jan is Magha panchami tithi day which covers purvahna, and consequently this day is the Vasanta Panchami day, and Sarasvati Puja day (Bengal and Orissa) as per Old School. However, in accordance with the Modern School, chaturthi ends at 30^h 03^m on 23 Jan 96 when panchami starts, and this tithi extends to 28^h 36^m on 24 Jan 96. Hence panchami tithi covers the purvahna of 24 Jan, and consequently Vasanta Panchami day and Saraswati Puja day is to be

observed on 24 Jan 96 as per Modern School. Thus there was a difference of one day in the observance of Vasanta Panchami and Sarasvati Puja in Magha, 1917 Saka, or in January, 1996, between the two Schools.

Again it will be seen that a tryahasparsha yoga happens on 23 Jan for Modern School but not so for Old School. This yoga means that the savana day is touched by three tithis, and is deemed by astrologers to be inauspicious for undertaking journeys, starting new adventures, etc. On this day (sunrise to sunrise) tritiya ends at 08^h 17^m in the morning when chaturthi starts, and it ends at 6^h 03^m next morning before sunrise which happens at 6h 19m at Calcutta, and 7^h 14^m at Delhi. Further, as per Modern School navami tithi completely overlaps the day 28 Jan 96, that is, it starts before sunrise of 28 Jan and ends after sunrise of 29 Jan, and this tithi is termed 'ahoratra', meaning day and night, and therefore there is no mention of 28 Jan in the Table under Modern School. However, tryahasparsha yoga occurs for both the schools on 18 Feb 96.

The inaccuracy of the positions of the sun and the moon, specially the latter, shown in the conservative Surya Siddhanta panchangs, can be easily detected at any time by astronomers by making telescopic observations, but it can also be perceived by the public at the time of eclipse by observing that the actual time of its occurrence vary considerably from that calculated as per Surya Siddhanta formula. To avoid this noxious situation which will make the public feel that the conservative Surya Siddhanta panchangs are erroneous, these panchang makers quietly copy the eclipse timings and other related information from modern astronomical ephemeris thus conceding the fact that their panchang timings are inaccurate. The difference in the timings shown in the two panchangs is causing at present a lot of confusion but this is likely to ease off soon as the Old School is gradually adopting modern methods for computing their panchangs.

Table XIII : Difference between the ending moments of the tithis as indicated in the panchang of the Old Conservative School and that of the Modern School, taking the example the lunar month of Magha of Vikram 2052, Saka 1917, or Gregorian 1995-96 AD

Sl.No. of Tithi	Lunar Month & Name of Tithi	Date and time of ending moments of tithis of the two Schools				Difference in time of the Old School from Modern School		
		Old School			Modern School			
1	2	3			4		5	
	Magha Sukla	1996	h	m	1996	h	m		h	m
S–1	Pratipada	21 Jan	16	51	21 Jan	14	36	+	2	15
S–2	Dvitiya	22 Jan	14	45	22 Jan	11	12	+	3	33
S–3	Tritiya	23 Jan	12	53	£ 23 Jan	08	17	+	4	36
S–4	Chaturthi	24 Jan	11	19	23 Jan	30	03	+	5	16
S–5	Panchami	@@ 25 Jan	10	08	@@ 24 Jan	28	36	+	5	32
S–6	Sasthi	26 Jan	09	23	25 Jan	28	00	+	5	23
S–7	Saptami	27 Jan	09	08	26 Jan	28	17	+	4	51
S–8	Ashtami	28 Jan	09	23	27 Jan	29	21	+	4	02
S–9	Navami	29 Jan	10	10	@ 29 Jan	07	05	+	3	05
S–10	Dasami	30 Jan	11	26	30 Jan	09	18	+	2	08
S–11	Ekadasi	31 Jan	13	05	31 Jan	11	48	+	1	17
S–12	Dvadasi	1 Feb	15	00	1 Feb	14	23	+	0	37
S–13	Trayodasi	2 Feb	17	43	2 Feb	16	55	+	0	48
S–14	Chaturdasi	3 Feb	19	21	3 Feb	19	18	+	0	03
S–15	Purnima	4 Feb	21	18	4 Feb	21	28	–	0	10
	Magha Krishna									
K–1	Pratipada	5 Feb	22	55	5 Feb	23	21	–	0	26
K–2	Dvitiya	6 Feb	24	08	6 Feb	24	57	–	0	49
K–3	Tritiya	7 Feb	24	52	7 Feb	26	12	–	1	20
K–4	Chaturthi	8 Feb	25	04	8 Feb	27	04	–	2	00
K–5	Panchami	9 Feb	24	45	9 Feb	27	28	–	2	43
K–6	Sasthi	10 Feb	23	58	10 Feb	27	22	–	3	24
K–7	Saptami	11 Feb	22	44	11 Feb	26	41	–	3	57
K–8	Ashtami	12 Feb	21	08	12 Feb	25	24	–	4	16
K–9	Navami	13 Feb	19	15	13 Feb	23	32	–	4	17
K–10	Dasami	14 Feb	17	07	14 Feb	21	07	–	4	00
K–11	Ekadasi	15 Feb	14	50	15 Feb	18	15	–	3	25
K–12	Dvadasi	16 Feb	12	28	16 Feb	15	03	–	2	35
K–13	Trayodasi	17 Feb	10	31	17 Feb	11	40	–	1	09
K–14	Chaturdasi	££ 18 Feb	07	51	££ 18 Feb	08	16	–	0	25
K–30	Amavasaya	18 Feb	29	45	18 Feb	29	00	+	0	45

Note:

1. Day for the purpose of reckoning tithi-days is the period from sunrise to sunrise, and so when the ending moment of a tithi falls between midnight and the next sunrise, then that ending moment has been indicated by adding with 24^h that time period beyond midnight, and is shown like $24^h\ 57^m$, $26^h\ 41^m$, $29^h\ 21^m$ etc.

2. £ shows the day when tryahasparsha yoga occurs for Modern School

3. @ Under Modern School, no tithi is shown on 28 Jan. This is because no tithi starts on that day (sunrise to sunrise). Navami tithi starts before sunrise of that day and ends after sunrise of the next day, 29 Jan, and thus overlaps the day of 28 Jan, and this tithi is designated as 'ahoratra'.

4. @@ Dates for celebration of Vasant Panchami and Sarasvati Puja by the two Schools: 25 Jan for Old School and 24 Jan for Modern School.

5. ££ shows the day when tryahasparsha yoga occurs for both the schools.

6. Ending moments of tithis shown for Modern School are from Rashtriya Panchang and from Bisuddha Siddhanta Panjika; and those shown for Old School are from Gupta Press Panjika and from P.M. Bagchi Panjika of Calcutta. ■

Festival Days of Other Religious Communities

It will be of interest to note that luni-solar system for fixing the days for celebrating various festivals including birth and death anniversaries of religious leaders, is not peculiar only to the Indian system. As a matter of fact, it is almost universally followed by all religious communities. The Muslims, as mentioned earlier, have adopted a lunar calendar based entirely on the motion of the moon, and hence as per this system the dates of their festivals move constantly in relation to the solar calendar and consequently with the seasons. The Christians, on the other hand, except for the Christmas, follow luni-solar calendric system for fixing the dates for celebrating most of their important festivals.

Christmas is celebrated on a fixed day with reference to the solar Gregorian calendar, which is 25th December. But equally important, perhaps more so for the Church, is the festival of Easter, which is the anniversary day of the resurrection of Jesus Christ after his crucification by the Jews two days earlier, which is reckoned to be Friday, and is called by the Christians as Good Friday. The resurrection thus happened on Sunday and is known to be Easter Sunday.

Jesus Christ was crucified on the day of the feast of the Jewish Passover festival which falls on the 14th day of the month of Nissan of the Jewish luni-solar calendar. On this basis, Easter Day is reckoned to be the first Sunday after the first full moon that occurs on or immediately after the spring equinox day, taken to be 21 March. Thus it is a movable frestival, like most of the Indian festivals, except that for fixing the date for celebration of Easter, consideration is given not only to the positions of the sun and the moon but also in addition of the occurrence of a particular week day, which is Sunday, and this results in this festival oscillating between 22 March and 25 April.

Not only Good Friday and Easter Sunday are movable festivals of the Christians, but many of their other important festivals, like Septuagesima Sunday, Quinquagesima Sunday, Ash Wednesday, Quadragesima Sunday, Palm Sunday, Low Sunday, Rogation Sunday, Ascension Day, Whit Sunday, Trinity Sunday, Corpus Christi, etc, are also movable in relation to the solar Gregorian calendar as the days for their celebration are laid down at a fixed number of days either before or after the Easter Sunday.

The luni-solar system of fixing the days of festivals has also been adopted by the followers of other religions, like Jews, Buddhists and Jains. Hence it may be said that

this practice is generally followed by all religious communities, and is not confined only to the Indian calendric system. ■

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